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U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF ANIMAL INDUSTRY.
D. E. SALMON, D. V. M., Chief of Bureau.

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CATTLE TICKS
(Ixodoidea)
OF THE
UNITED STATES.

BY

D. E. SALMON, D. V. M.,
Chief of Bureau of Animal Industry,

AND

CH. WARDELL STILES, Ph. D.,
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THE CATTLE TICKS (IXODOIDEA) OF THE UNITED STATES.

By D. E. Salmon, D. V. M.,
Chief of Bureau of Animal Industry,

and

Ch. Wardell Stiles, Ph.D.,
Zoologist of Bureau of Animal Industry.

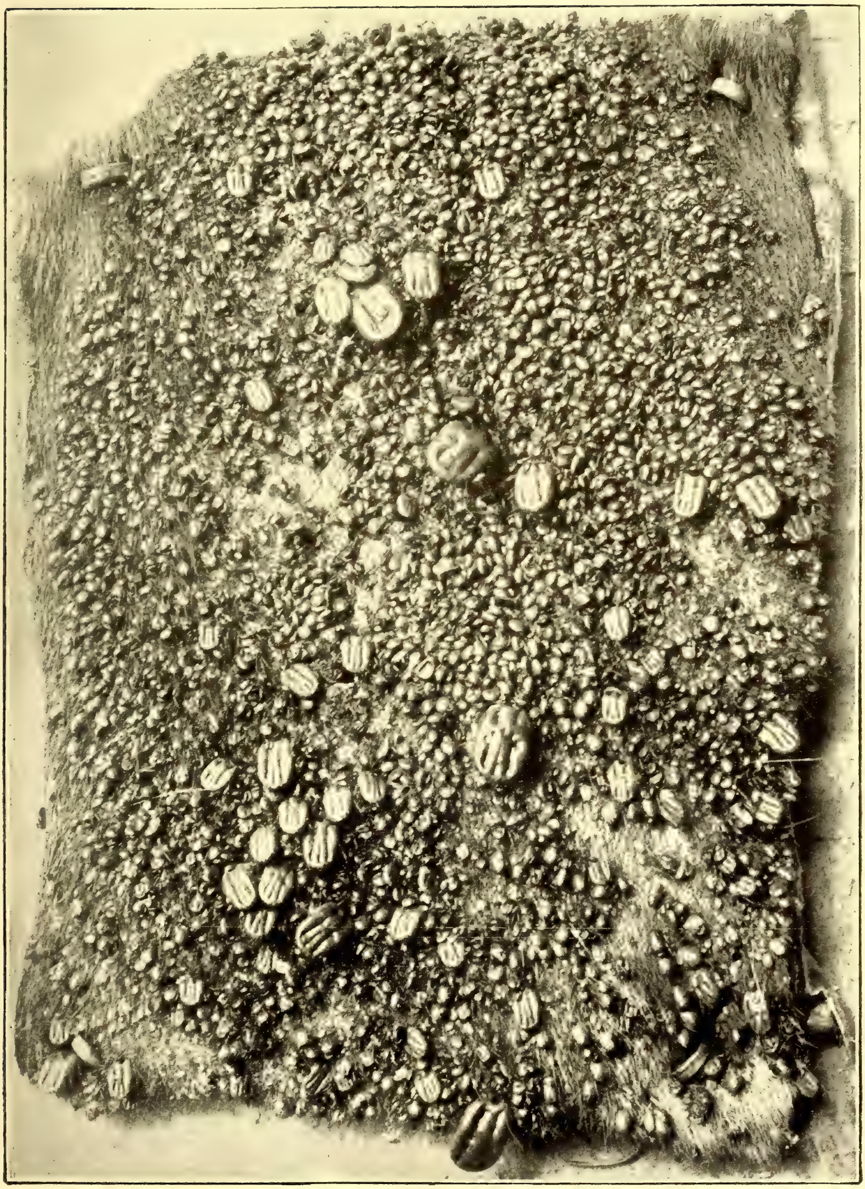
INTRODUCTION.

Objects of the present paper.—The present paper is intended primarily as a guide to the inspectors of the Bureau of Animal Industry in their quarantine work against Texas fever. On this account only such forms will be described and figured in detail as inspectors are more likely to find on cattle. Brief reference will be made, however, to other genera and species, since it can not be foreseen what forms may be accidentally found. We are especially likely to meet with some of the numerous Mexican and Central American species which may be accidentally spread, particularly to the Southern States, by migratory birds, by imported animals, by produce, or by travelers. Once introduced in this way it is in many cases a matter of chance whether they will attack cattle. Our closer relations with Porto Rico, Cuba, and the Philippines also present increased opportunities for the introduction of exotic ticks into the United States.

The importance of being able to recognize the Texas fever tick (fig. 42) (*Boophilus annulatus*, more commonly known as *Boophilus bovis*) and to eliminate other forms is immediately apparent when it is recalled that the Texas fever quarantine line, extending from the Atlantic to the Pacific, is based upon the presence or absence of this species.

Arrangement of paper.—The present paper is so arranged that an inspector may inform himself in a very short time in regard to the common ticks of cattle. For this purpose he should study the text which is printed in the larger type and the illustrations. The descriptions and keys, printed in the smaller type, are intended for use in connection with specimens.

Ticks which are sent in for determination should be addressed to the



Portion of a Steer's Hide, showing the Texas Fever Tick (Boophilus annulatus) of the United States. Natural Size. Original.

"Bureau of Animal Industry, for Zoological Laboratory." It is always better to forward *live* specimens when possible, and to send several of each sex if they can be obtained. For transmission they may be placed, without packing, in a pill box or other convenient receptacle.

Method of examination.—In many cases a tick taken from cattle may be quite positively determined without the aid of a microscope. In view of the importance of avoiding an incorrect determination it is, however, advisable to examine the specimens with a hand lens. No preserving fluid or technique is necessary. The specimen is simply held between the thumb and first finger of the left hand, so that it may easily be turned, and the magnifying glass held in the right hand and brought into focus.

If finer microscopic work is desired, the specimen may be killed in boiling water or alcohol. The next step depends upon the nature of the study proposed. If ordinary glycerin preparations of the hard parts are desired the specimen is dissected, the soft parts being cut away as much as possible. The structure intended for mounting may then be placed in a 2 to 10 per cent solution of caustic potash until the remaining soft tissues are destroyed. Next, transfer the specimen to water, in which it is left (the water being changed once or twice) until the caustic is washed out. Finally, the object is placed on a slide, a drop of glycerin added, and the specimen protected with a cover slip; or, if a balsam mount is desired, the specimen is washed as above, after being treated with caustic and then, after being dehydrated by placing it successively in alcohol of 50, 70, 95, and 100 per cent, transferred to xylene or like fluid and mounted in balsam. Very satisfactory mounts of an entire male, nymph, or larva may be made by the above methods.

Section cutting of ticks is difficult and tedious, owing to the thick tegument. A method used by zoologists gives very good sections when one has the patience to carry it out. The entire body is prepared in the usual way—killed in hot water, sublimate solution, or alcohol—then passed through alcohol (70, 90, and 100 per cent) and xylene, and embedded in paraffin. Before each section is made with the microtome, the exposed surface of the embedded object is covered with a thin film of a colorless solution made from mastixcollodion, absolute alcohol, and ether. The sections are fastened to the slide by a thin film of a solution of equal parts of glycerin and albumen, then treated in the usual way—dissolve paraffin, stain sections, dehydrate, and mount.

Classification, synonymy, and literature.—Quite recently Prof. L. G. Neumann has completed a monographic revision of the ticks of the world. For this work he has had not only almost the entire collection of Ixodoidea belonging to this Bureau, but also specimens from numerous other laboratories and collections.

As the ticks belonging to the Bureau are still in his possession, we have been obliged to depend very largely upon Neumann's papers for the analytical keys to the species of the different genera. Some of the characters selected by him appear to us, however, rather difficult to use. We have accepted Neumann's synonymy[1] in almost every instance except in *Boophilus*, since he has had at his disposal not only a large number of specimens, but many types as well. Neumann's classification is here followed, except for some slight changes. It seems to us, for instance, that the differences between the two chief groups of ticks are sufficiently great to admit of two families, rather than two subfamilies. We also recognize the genus *Boophilus*, and in this we distinguish, with Fuller, at least three species, namely, *B. annulatus*, *B. australis*, and *B. decoloratus*.

In selecting the technical names the International Code of Nomenclature has been followed. It must, however, be remarked that a comparison of original type specimens may eventually result in slight changes in the nomenclature adopted. Most of our technical names agree with those adopted by Neumann, but we have considered it necessary to use *Ixodes ricinus* instead of *I. reduvius*, and to differ from Neumann in regard to Linnæus's *Acarus americanus*. (See p. 488.)

In connection with the synonymy brief bibliographic citations have been given, but no effort has been made to publish a complete bibliography of the species discussed. The Harvard short method of citation has been followed; full references may be obtained by consulting the bibliography (pp. 478–488).

THE POSITION OF THE TICKS IN SYSTEMATIC ZOOLOGY.

Ticks are placed by zoologists in the Arthropoda, a very extensive group, or phylum, which includes all animals possessing an external chitinous skeleton, a ventral nervous system, dorsal digestive system, together with jointed extremities. The group Arthropoda is divided into a number of classes, the more important of which are—

HEXAPODA, or INSECTA (insects), provided with three pairs of legs.

MYRIAPODA (thousand legs), provided with numerous pairs of legs.

ARACHNOIDEA (spiders, ticks, mites, etc.), provided with four pairs of legs.

CRUSTACEA (crabs, lobsters, etc., in most cases aquatic arthropods), usually with a pair of extremities to each segment.

Ticks belong to the class Arachnoidea, order Acarina, and are thus closely related to the mites which produce scab, mange, and itch. Acarines may be divided into the following families:

---

[1] Many of the descriptions of ticks given by early authors are so incomplete that a positive synonymy of all of the forms is out of the question. In many cases it is impossible clearly to recognize the species with which an author is dealing, even when he uses for it the name of a very commonly known form. On this account it is frequently necessary to accept in synonymy a bibliographic reference to a given name simply because it is impossible to prove definitely that the reference under consideration does not deal with some other species than the one indicated by its name.

A.—Body elongated.—*Vermiformia.*

No tracheæ. Legs with epimeres.	Two pairs of legs. Palpi unarmed. Mandibles styliform.	Phytoptidæ.
	Four pairs of legs. Palpi uncinate. Mandibles styliform.	Demodicidæ.

B.—Body compressed.—*Acarina.*

No tracheæ. *Astigmata.* Legs with epimeres.	Palpi joined at base, unarmed. Mandibles chelate.	Sarcoptidæ.
Tracheæ opening in the anterior portion of the body, atrophied in the aquatic forms. *Prostigmata.* Legs with epimeres.	Palpi free, unarmed; anteniform. Mandibles chelate.	Bdellidæ.
	Palpi free, armed. Mandibles with hooks, or styliform.	Marine: Halacaridæ. Fresh water: Hydrachnidæ. Terrestrial: Trombidiidæ.
Tracheæ opening in the posterior portion of the body, at the base of the legs, sometimes atrophied. *Metastigmata.* Legs without epimeres.	Palpi free, fusiform, mandibles chelate.	Oribatidæ.
	Palpi free, filiform or valvate. Mandibles, pseudo-chelate.	Argasidæ: Ixodidæ.
	Palpi free, filiform. Mandibles chelate.	Gamasidæ.

Superfamily Ixodoidea[1] Banks, 1894.

From the table of synonymy given in the footnote, it will be seen that there has been considerable difference of opinion relative to the systematic rank to be given to this group, the latter having been recognized by various authors as representing a distinct family, superfamily, suborder, and order. To our minds Banks's proposition of a superfamily seems the best, hence it is adopted here.

---

[1] Synonymy and Bibliography.

1804: Fam. *Riciniæ* (in part) Latreille, 1804, pp. 46–53.—Idem, 1829, pp. 286–289.—Risso, 1826, pp. 180–184 (pars).—Oudemans, 1896, pp. 191–197. [See also Trouessart, 1891, p. 290.]
1815: Fam. *Ixodides* Leach, 1815, pp. 396–399.—Fuller, 1896, p. 763.
1837: Fam. *Ixodea* Burmeister, 1837, p. 579.—Grube, 1859, p. 455.—Gerstaecker, 1860, p. 464.
1847: Order *Ricini* Koch, 1847, pp. 5–136.—Fürstenberg, 1861, p. 208.—Canestrini, 1890, p. 482. [See also Trouessart, 1892, p. 298.—Marx, 1892, p. 232.]
1855: Fam. *Ixodida* Küchenmeister, 1855, pp. 421–424.—Kolenati, 1857, pp. 19–24.
1863: Fam. *Ixodidæ* Gerstaecker, 1863, pp. 343, 344.—Conil, 1877, pp. 28, 29.—Claus, 1880, p. 652.—Michael, 1884, p. 50.—Berlese, 1855, p. 131.—Ludwig, 1886, p. 612.—Riley, 1887, pp. 744, 745.—Marx, 1892, p. 232.—Trouessart, 1892, pp. 28, 33, 37, 38, 45, 46, 47.—Neumann, 1892b, pp. 94, 95–105.—Railliet, 1893, pp. 631, 703–718.—Osborn, 1896, pp. 255–262.—Morgan, 1899, pp. 136, 141.—

This superfamily may be divided into two families—Argasidæ and Ixodidæ.

The family Argasidæ (p. 400) is composed of two genera—*Argas* and *Ornithodoros*—while the family Ixodidæ (p. 414) may be further subdivided into the two subfamilies Rhipicephalinæ, with the four genera *Rhipicephalus*, *Boophilus*, *Hæmaphysalis*, and *Dermacentor*, and Ixodinæ, with the five genera *Ixodes*, *Eschatocephalus*, *Aponomma*, *Amblyomma*, and *Hyalomma*.

All of these groups may be readily distinguished by the following key:

KEY TO THE FAMILIES, SUBFAMILIES, AND GENERA OF THE SUPERFAMILY IXODOIDEA.

[For genera already reported on cattle in the United States, follow Roman type.]

1. Scutum absent .... Argasidæ, 2.
Scutum present .... Ixodidæ, 3.

FAMILY ARGASIDÆ.

2. Capitulum removed by at least its length from the anterior margin; body rounded anteriorly, without a projecting beak-like prominence; eyes absent .... *Argas*, p. 401.
Capitulum hidden under a projecting beak-like prominence (hood), so close to anterior margin that the tips of the palpi project from under the body and are visible from above; eyes present or absent .... *Ornithodoros*, p. 407.

FAMILY IXODIDÆ.

3. Palpi short, subtriangular, not or only slightly longer than broad; capitulum short; front of body emarginate for insertion of capitulum .... *Rhipicephalinæ*, 4.
Palpi longer than broad; capitulum long; front of body straight or emarginate .... *Ixodinæ*, 7.

Ward, 1900a, pp. 193–205.—Idem, 1900b, pp. 430, 435–437.—Stiles & Hassall, 1901, p. 1. [See also Trouessart, 1891, pp. 291, 294, 301, 305, 308.]

1876: Fam. *Ixodidés* Mégnin, 1876, p. 293.—Idem, 1877, p. 86.—Idem, 1880, pp. 117–136.—Railliet, 1886, pp. 495–502.—Idem, 1893, pp. 703–718.—Neumann, 1888, pp. 82, 87–96, 219–221.—Idem, 1892a, pp. 90, 91, 92–101, 221–223.—Idem, 1896, pp. 1–44.—Idem, 1897, pp. 324–420.—Idem, 1899, pp. 107–294.—Blanchard, 1890, pp. 322–339.

1876: Fam. *Ixodæ* Wagner, 1876, p. 129.

1892: Order *Metastigmata* Canestrini, 1892, pp. 580–582, 587. Probably earlier. [See also Trouessart, 1892, p. 28.]

1892: Suborder *Cynorhæstea* Marx, 1892, pp. 233–236.—Morgan, 1899, p. 136.

1894: Superfam. *Ixodoidea* Banks, 1894, p. 209.—Salmon & Stiles, 1901, pp. 383–488.

SUBFAMILY RHIPICEPHALINÆ.

4. Dorsal surface of capitulum hexagonal, the sides being drawn out laterally into a sharp point; anal plates present on male; eyes present ---------- 5.
Dorsal surface of capitulum rectangular, sides straight; male without anal plates; eyes present or absent (*Anopli* Canestrini, 1890, p. 491) ---------- 6.
5. *Second and third palpal articles straight, not drawn out laterally into sharp points; stigmata comma-shaped* ------ *Rhipicephalus*, p. 415.
Second and third palpal articles drawn out laterally into sharp points; stigmata nearly round -------- *Boophilus*, p. 419.
6. *Coxæ I not bidentate; coxæ IV of normal size; eyes absent* - *Hæmaphysalis*, p. 456.
Coxæ I bidentate in both sexes; coxæ IV much larger than I to III; eyes present ---------- *Dermacentor*, p. 447.

SUBFAMILY IXODINÆ.

7. Anal groove surrounds anus anteriorly and opens posteriorly; eyes absent ---------- 8.
Anal groove surrounds anus posteriorly and opens anteriorly ---------- 9.
8. Palpi valvate on median surface, in both sexes ---- *Ixodes*, p. 459.
Palpi claviform, not valvate in male; legs very long -------- *Eschatocephalus*, p. 468.
9. *Eyes absent; anal plates absent* ---------- *Aponomma*, p. 469.
Eyes present ---------- 10.
10. Anal plates absent ---------- *Amblyomma*, p. 470.
Anal plates present on males ---------- *Hyalomma*, p. 477.

TICKS OF THE UNITED STATES THUS FAR REPORTED FOR CATTLE.

Thus far the following eight species of ticks have been reported for cattle in this country, and it is these forms in particular which stock inspectors should hold in mind:

Argas miniatus, the Southern chicken tick, has been reported from cattle but once. (See p. 402.)

Ornithodoros Megnini, the ear tick, is more or less common, especially in the Southwest. (See p. 408.)

Boophilus annulatus, the North American Texas fever tick, is very common below the Texas fever line. (See p. 420.)

Dermacentor reticulatus, the net tick, is reported for California, Texas, New Mexico, and Indian Territory; it probably has a much more extensive distribution. (See p. 448.)

Dermacentor electus, the American dog tick, has a very wide range on this continent, being found both North and South. (See p. 455.)

Ixodes ricinus, the castor-bean tick, is common in many States of the Union. (See p. 462.)

Ixodes hexagonus, a European dog tick, is found particularly east of the Rocky Mountains. (See p. 467.)

Amblyomma americanum, the Lone Star tick, has a very wide distribution on the American continent, and is one of the most easily recognized species found on cattle. (See p. 474.)

Several other supposed distinct species have been mentioned by various American authors as infesting cattle in the United States, but it is probable that all of them are identical with one or another of the above-named forms. Thus, *Amblyomma unipunctatum* is identical with *A. americanum; Boophilus bovis* is identical with *B. annulatus; Dermacentor occidentalis* is identical with *D. reticulatus;* and *Ixodes scapularis* = (?). (We have not yet been able to recognize this last species.)

In the keys to the various ticks which are published in this paper, the cattle ticks of the United States have been compared with Ixodoidea found on other animals and also in other countries. The following artificial key to the above-mentioned eight species will be found somewhat easier to follow until the inspector becomes acquainted with the most common forms:

ARTIFICIAL KEY TO EIGHT TICKS REPORTED FROM CATTLE IN THE UNITED STATES.

[For the Texas fever tick, follow Roman type.]

1. Scutum present .... 2.

   Scutum absent .... 5.

2. Scutum uniformly dark, or nearly so .... 3.

   Scutum partially white or yellow .... 4.

3. Palpi less than half as long as the capitulum is broad ......
   Boophilus annulatus, p. 420.

   Palpi as long as the capitulum is broad, or even longer .....
   Ixodes ricinus, p. 462, *and I. hexagonus*, p. 467.

4. *A single bright spot at posterior angle of female scutum* ....
   Amblyomma americanum, p. 474.

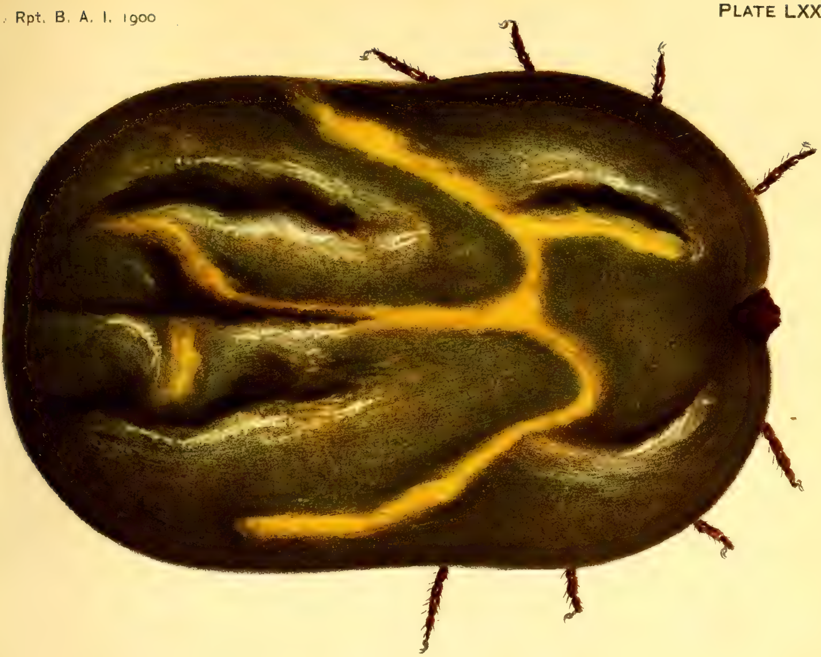
   White extends to anterior portion of female scutum ....
   Dermacentor electus, p. 455, *and D. reticulatus*, p. 448.

5. *Found in the ear; body violin-shaped* ....
   Ornithodoros Megnini, p. 408.

   Body oval; tegument with radiate lines of dots ....
   Argas miniatus, p. 402.

It is needless to state that this key is given only as an additional aid, in the way of a "ready reference," to help inspectors to become more familiar with the species. If a determination is made by means of

43



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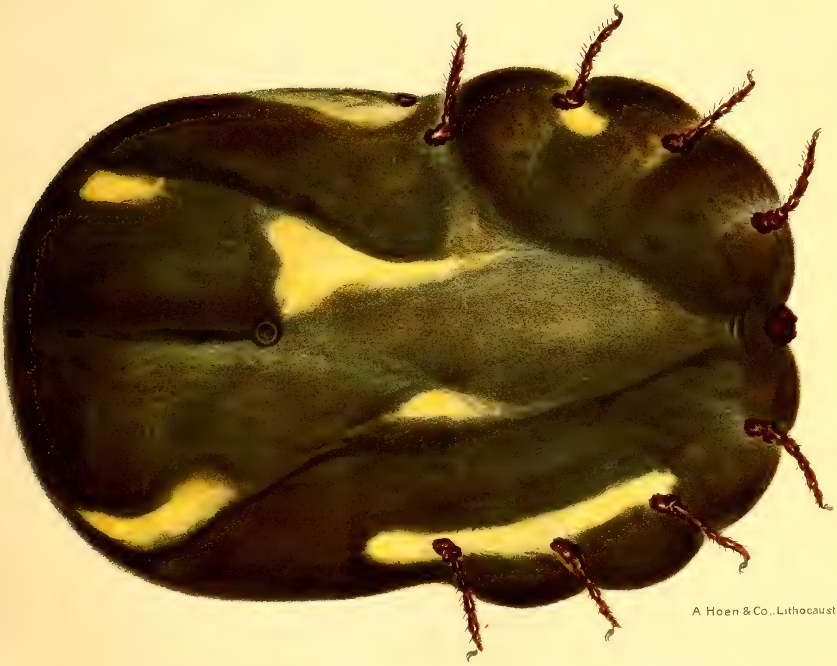

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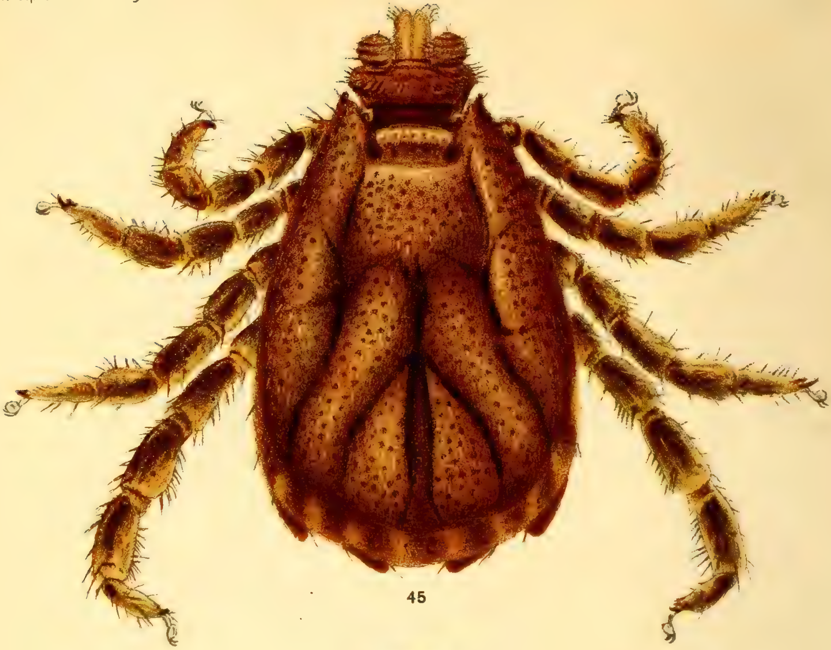
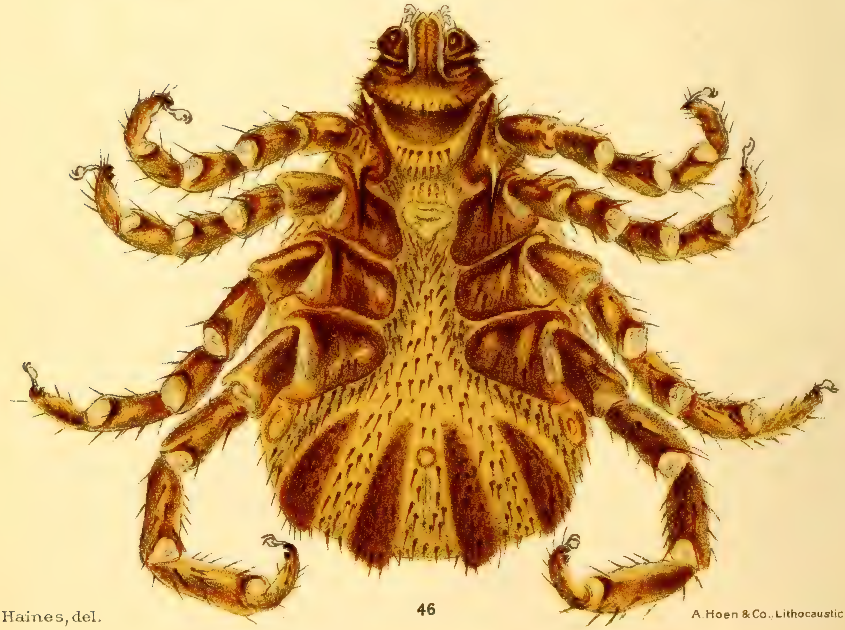
FIG. 43. DORSAL VIEW OF REPLETE FEMALE BOOPHILUS ANNULATUS. GREATLY ENLARGED. ORIGINAL.

FIG. 44. VENTRAL VIEW OF SAME.





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A. Hoen & Co., Lithocaustic.

FIG. 45. DORSAL VIEW OF MALE BOOPHILUS ANNULATUS OF THE UNITED STATES. GREATLY ENLARGED. ORIGINAL.

FIG. 46. VENTRAL VIEW OF MALE BOOPHILUS ANNULATUS OF THE UNITED STATES. GREATLY ENLARGED. ORIGINAL. THE SPINES ON COXÆ I ARE UNUSUALLY LARGE.

PLATE LXXVI.

FIG. 45.—Dorsal view of male *Boophilus annulatus* of the United States. Greatly enlarged. Original.

FIG. 46.—Ventral view of male *Boophilus annulatus* of the United States. Greatly enlarged. Original. The spines on coxæ I are unusually large.

this artificial table, it should, of course, be verified by means of the illustrations, the more detailed keys, or the descriptions.

It may here be mentioned that the common sheep tick was formerly supposed to be closely related to the cattle ticks and dog ticks, and in the writings of pre-Linnæan authors the terms lice, ticks, *Reduvius*, and *Ricinus* cover much more than they do to-day. Even Linnæus as late as 1761 mentions the sheep tick (*Melophagus ovinus*) as an acarine (*Acarus reduvius*). Gradually, however, by the process of elimination, the sheep tick has been placed where it belongs—in the insects—but it has still retained its old vernacular name which it has had for several centuries.

THE GENERAL STRUCTURE OF TICKS.

In order properly to determine a tick it is necessary to become acquainted with the general anatomical parts, particularly with the external anatomy, and to understand the technical terms used. Unfortunately there is considerable confusion in regard to the terminology as adopted by various authors. This is largely due to attempts to homologize the various structures of the tick with corresponding structures of the insects. The terminology used in this paper may be seen from figs. 43 to 68.

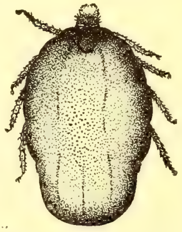


FIG. 47.—Dorsal view of nymph of *Boophilus annulatus* of North America. Greatly enlarged. Original.

The ticks are air-breathing arachnoids, which are always large enough to be seen with the naked eye; young specimens just born are very small, but still visible without the aid of a microscope; fully replete forms may be over half an inch in length. Several different forms are recognized in each species, as given below:

Adult or replete females (figs. 43, 44), which have eight legs.

Adult males (figs. 45, 46), also with eight legs, usually somewhat smaller and flatter than the females.

Nymphs (fig. 47), which are half-grown eight-legged females.

Larvæ (figs. 48, 49), which are six-legged and without sexual orifice.

Eggs (fig. 50), which have a rather hard, leathery shell.

Young specimens and males are rather flat; females become rounded and plump with increasing age.

Upon even a superficial examination it will be noticed that ticks are composed of two more or less distinct portions united by an articulation. These parts are known as the *capitulum*, or *head*, and the *body*. By using these terms in this manner we do not intend to imply that all of the parts of the head of the insects are contained in the capitulum.

I. CAPITULUM, OR HEAD.—The capitulum (figs. 52–54), also known as the head or the rostrum, is the small anterior structure with the mouth parts; it is attached to the anterior extremity (figs. 45, 46) in the family Ixodidæ and in the larvæ (fig. 101) of the family Argasidæ. It is hidden under the anterior extremity (fig. 71) in older stages of the family Argasidæ. Several different parts may be distinguished, as follows:

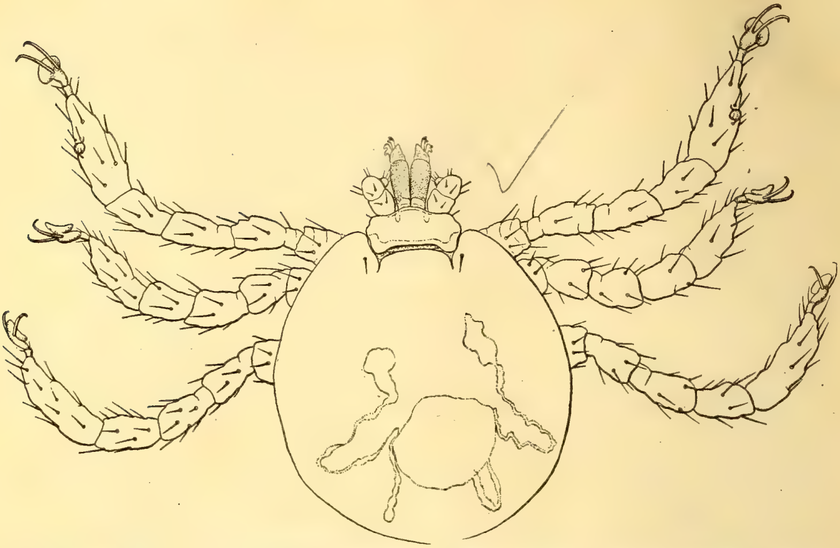


FIG. 48.—Dorsal view of larva of *Boophilus annulatus* of North America. Greatly enlarged. Original.

(1) The *base of the capitulum* (capituli basis, mouth shield) is the hard basal portion (fig. 54) which is articulated proximally by a neck-like structure (fig. 54) in the emarginated antero-median portion (camero-

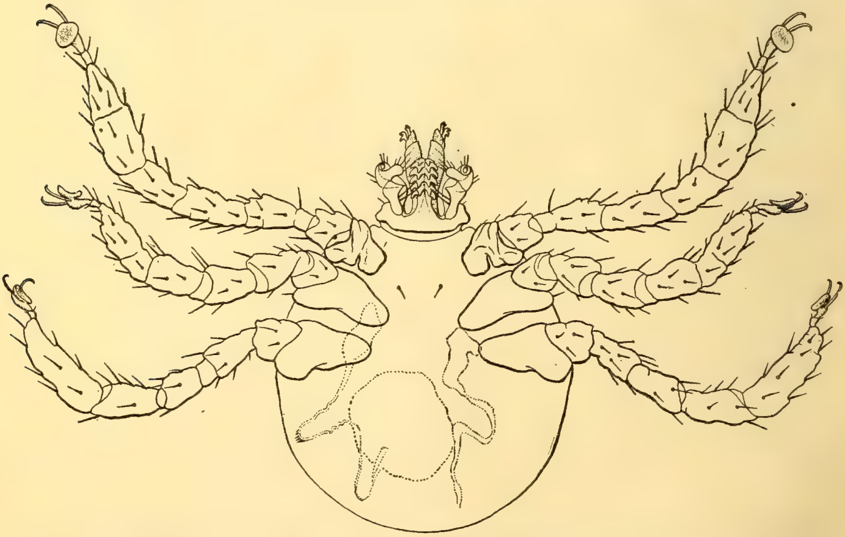
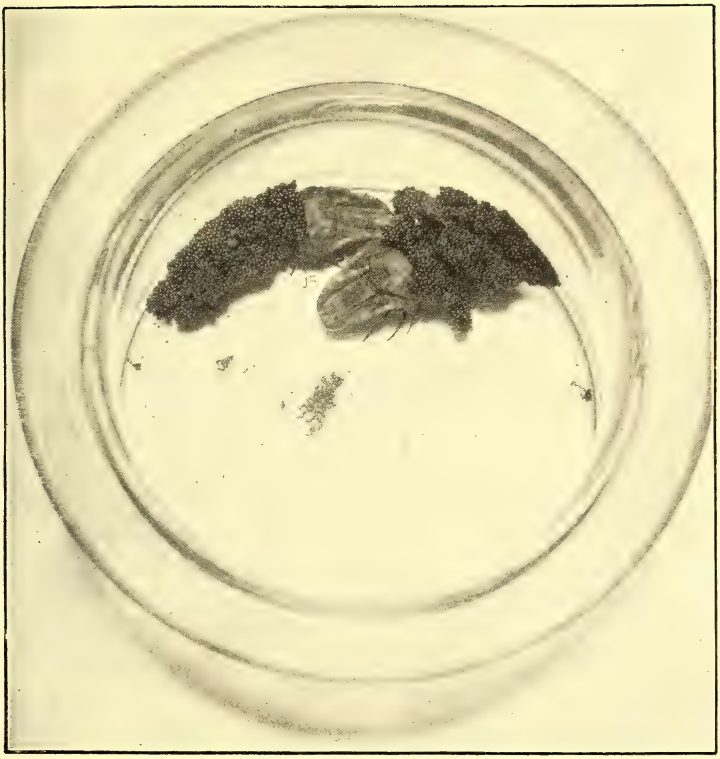


FIG. 49.—Ventral view of larva of *Boophilus annulatus* of North America. Greatly enlarged. Original.



TWO FEMALE TICKS (HYALOMMA ÆGYPTIUM) OVIPOSITING. NATURAL SIZE.
(Photograph by J. E. Emery.)

stome) of the body (fig. 54) and scutum. Viewed from above, it usually presents a square to elongate surface, the postero-lateral corners (fig. 54 *p. l.*) of which are often sharply pointed and spine-like. The outline varies in different species and genera. In some cases it presents a sharp lateral projection. In the females two *porose areas* (areæ porosæ, fovæ porosæ) are found on the upper surface (fig. 60). These structures have different outlines in different kinds of ticks, and are occasionally mistaken for eyes. Anteriorly the base bears the mouth parts (fig. 54) or oral appendages known as the *hypostome*, *mandibles*, *mandibular sheaths*, and *palpi*. The hypostome, mandibles, and mandibular sheaths, are together sometimes called the *haustellum* (proboscis, or, with some authors, the rostrum). In some writings the terms proboscis and rostrum also include the palpi.

FIG. 50.—Egg of *Boophilus annulatus* of North America. Greatly enlarged. Original.

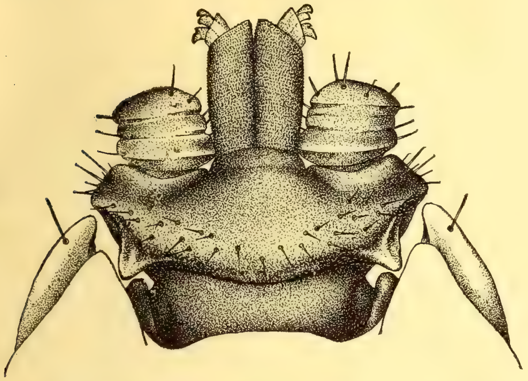


FIG. 52.—Dorsal view of capitulum, or head, of male *Boophilus annulatus* of North America. Greatly enlarged. Original.

(2) The *hypostome* (tongue, labium, or radula) (fig. 54) lies ventrally underneath the mandibles, and is best seen on ventral view. It is an elongate dart or spatulate structure, which is composed of two lateral symmetrical halves (figs. 53, 55). Its ventral surface is armed with numerous minute teeth, called *denticles*, their points being directed toward the body. As a rule there are numerous denticles at the tip, which are not arranged in distinctly regular rows. A short distance from the tip the denticles become larger and are arranged in quite regular longitudinal rows. In most species these rows are so placed that the corresponding denticles of each row form a more or less regular transverse row. The number of longitudinal rows varies in different species, and forms an

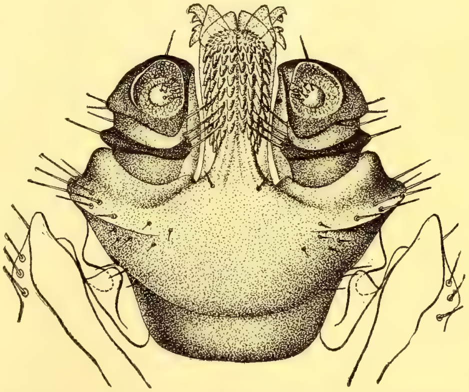


FIG. 53.—Ventral view of capitulum of male *Boophilus annulatus*. Greatly enlarged. Original.

important character for classifying ticks. Thus, in the Texas fever tick (*Boophilus annulatus*), found in the United States, and in the corresponding tick (*B. australis*) found in Cuba, Porto Rico, certain parts of South America, India, and Australia, there are eight rows—four rows on each half. In *Boophilus decoloratus*, of South Africa, there are six rows—three rows on each half. Now and then a tick is met with which varies slightly from the general rule, thus resulting in some difficulty in determination. Quite recently, in a sending of ticks from Cuba, all the males corresponded with the males of *B. australis*, but one individual presented six rows of denticles instead of eight.

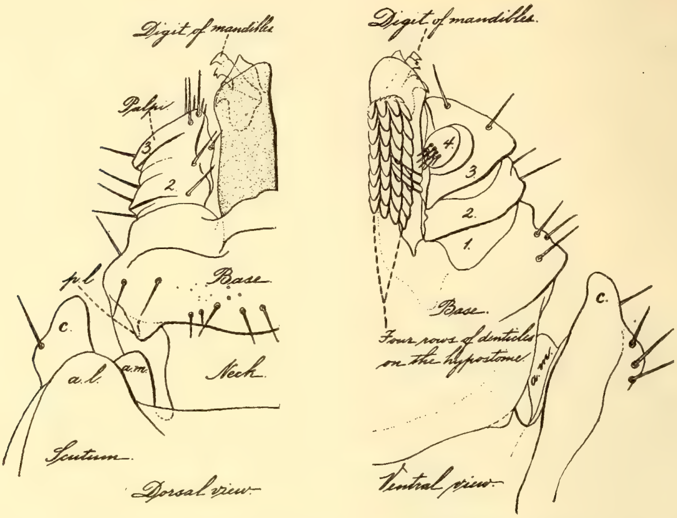


FIG. 54.—Outline drawing of dorsal and ventral views of one-half of capitulum of male *Boophilus annulatus*. Note the following parts: Base with *p. l.*, posterior lateral projection; palpi, *1*, *2*, *3*, *4*, first, second, third, and fourth palpal articles; digit of mandibles; sheath of mandibles; four rows of denticles on hypostome. The neck and front part of the body are also shown; scutum, with *a. l.*, antero-lateral projections, and *a. m.*, antero-median projections; *c*, anterior projection of coxa I. Greatly enlarged. Original.

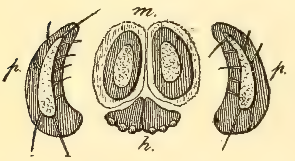


FIG. 55.—Transverse section through the mouth parts of *Hyalomma ægyptium*: *p*, palpi; *m*, mandibles; *h*, hypostome with denticles. After Neumann, 1892a, p. 93, fig. 54.

(3) The *mandibles* (cheliceræ, or jaws) are two in number, representing a pair of elongate structures (fig. 56), one of which is situated on each side of the median line, both lying dorsal (figs. 53–55) of the hypostome. They may be seen either in dorsal or in ventral view of the capitulum, and occasionally appear as if they were a part of the hypostome, thus leading to confusion. A slight pressure, however, usually separates them more distinctly from the hypostome. The *proximal half* or *third* is swollen to contain the muscular insertions. The *distal half* or *two-thirds* is flat and narrow and terminated anteri-

orly by a *digit*, which is recurved at its anterior free extremity in a dorsal hook. This digit bears either two or three processes, known as the *apophyses*, which are unequal in size—the *internal* or lesser apophysis, the *external* (away from the median line) or greater apophysis, and the *middle* apophysis—situated between the internal and the external. Each apophysis bears one or more thorn-like or hook-like teeth, more or less recurved toward the base of the capitulum. Some authors attach considerable importance to the number and arrangement of these teeth in classifying ticks. Our own experience has been that the teeth of the external apophysis are subject to variation among the individuals of given species, hence not reliable as systematic characters; while the teeth of the internal apophysis are usually so difficult to recognize with certainty that, whatever may be their systematic value, we are disposed to select other characters.

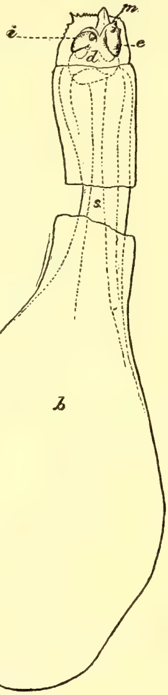


FIG. 56.—Dorsal view of mandible of *Argas miniatus*, showing the base *b*, stem *s*, digit *d*, external *e*, internal *i*, and median *m* apophyses. Greatly enlarged. Original.

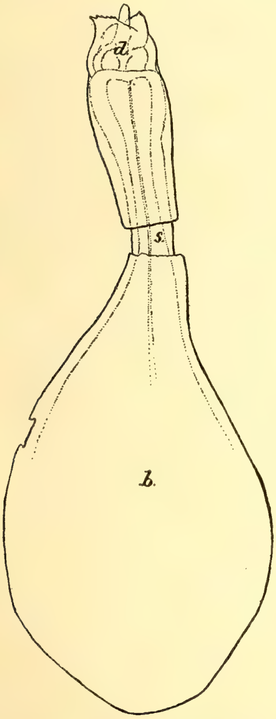


FIG. 57.—Ventral view of same. Original.

(4) The *mandibular sheath* (figs. 54, 55) lies dorsal of the mandibles, and often appears as though it were a direct prolongation of the base of the capitulum. The sides are curved ventrally at the sides of the mandibles. The anterior extremity is notched in the median line, and a distinct line (fig. 52) can often be traced from this point to the base of the capitulum, while a slight pressure not infrequently results in separating the structure into two distinct halves corresponding to the mandibles. Examination under a microscope often reveals numerous fine structures on the exposed surface, giving to it the appearance of a file.

As stated above, the hypostome, mandibles, and mandibular sheaths, taken together, represent the haustellum (sometimes called the beak). These are the structures which are inserted into the skin of the animal (fig. 54) upon which the ticks are parasitic. The arrangement of the denticles and teeth, with points directed toward the tick's body, enables the parasites to hold so firmly to their victim that it frequently happens that the capitulum is torn from the body of the tick and left in the skin of the host when an attempt is made to remove the parasites by force.

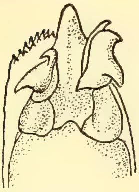


FIG. 58.—Digit of mandible of same. After Neumann, 1896, p. 10, fig. 9.

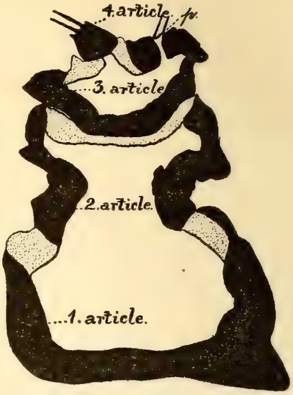


FIG. 59.—Longitudinal section through a palpus of *Boophilus annulatus*. The articles are black, the articulations dotted. Note the pore (*p*) which pierces the entire cuticle. Original.

(5) The *palpi* (figs. 52–55) are inserted on the base of the capitulum, in some cases rather dorsally, in others rather ventrally, one on each side of the haustellum. Each *palpus* is composed of four *articles* joined together in a row by *articulations* (fig. 59). These articles are called: *First*, or *basal*, *article* (nearest the base of the capitulum); *second*, or *antepenultimate*, *article; third*, or *penultimate*, *article;* and, *fourth*, or *apical*, *article*. They are more or less excavate on their median or internal side (the side toward the mandibles and hypostome), so that they form a more or less distinct sheath to these structures. Their *ventral*, *dorsal*, *lateral* (or *external*), and *median* (inner) aspects vary in appearance in different ticks.

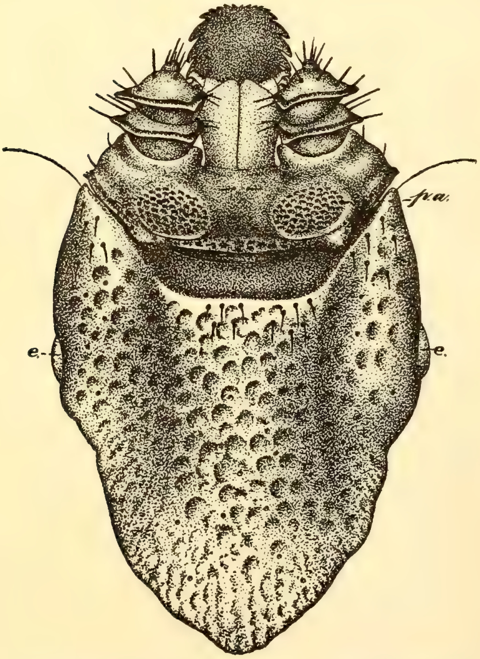


FIG. 60.—Scutum and scutellum of female *Boophilus annulatus*, showing mouth parts, porose areas (*p. a.*), and eyes (*e*). Greatly magnified. Original

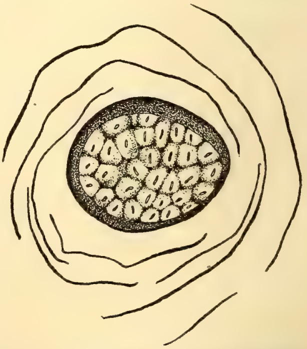


FIG. 61.—Dorso-submedian porose plate of *Dermacentor reticulatus*. Greatly magnified. Original.

The palpi are provided with *hairs*, *bristles*, *edges*, *angles*, and *spines*, which vary in different ticks.

The form of the palpi is an important character in classifying ticks in their respective genera.

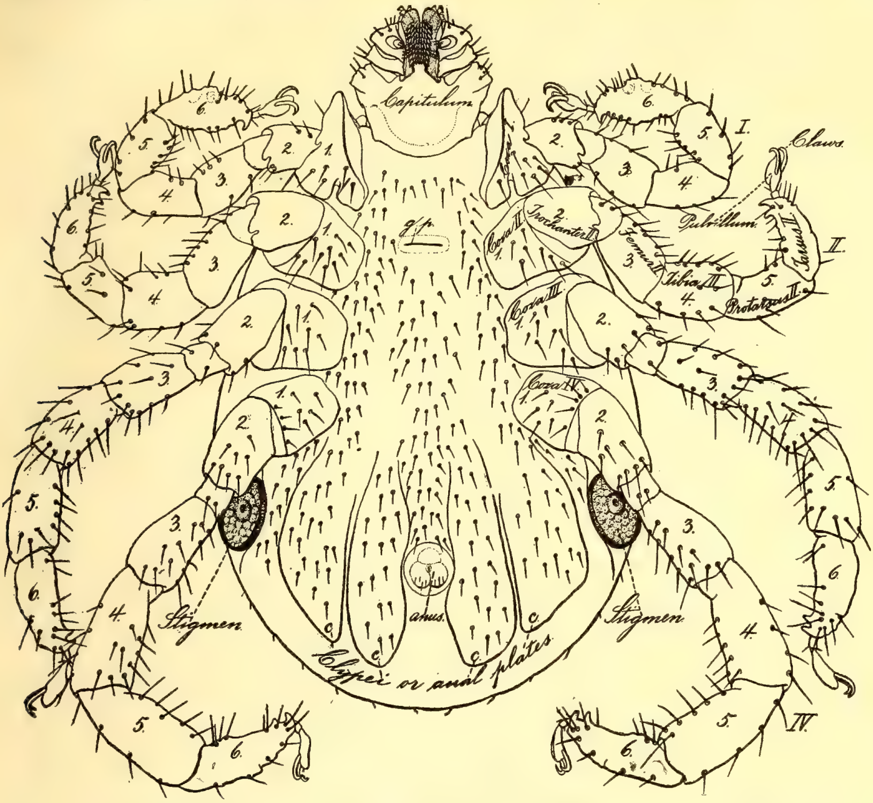


FIG. 62.—Outline ventral view of male *Boophilus* to show structures used in classification: anus; clypei or anal shields; *g. p.*, genital pore; legs I to IV; the names of the articles are written on the leg II. Greatly enlarged. Original.

II. BODY.—The body (figs. 42–49) varies greatly in form, being different in color, outline, and structure, not only in the different genera and species, but also in the two sexes of the same species and in the different stages of the same sex. This extreme variety of appearance has led some observers to describe the different members of one and the same species as representatives of different species, and accounts to a great extent for the confusion in the classification. An individual specimen, if alive, will even change color while it is being studied.

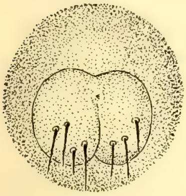


FIG. 63.—Anus of *Boophilus annulatus.* Greatly enlarged. Original.

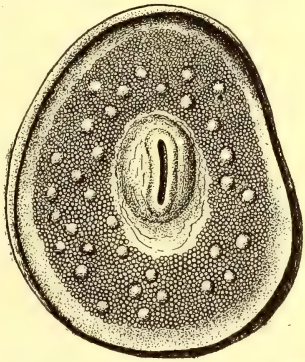


FIG. 64.—Stigmen of female *Boophilus annulatus.* Greatly enlarged. Original.

Species based upon color alone must, therefore, usually be viewed as probably invalid.

On the body may be recognized *dorsal surface*, *ventral surface*, *sides*, or *lateral margins*, and *anterior* and *posterior margins*, all of which possess structures which are of systematic importance.

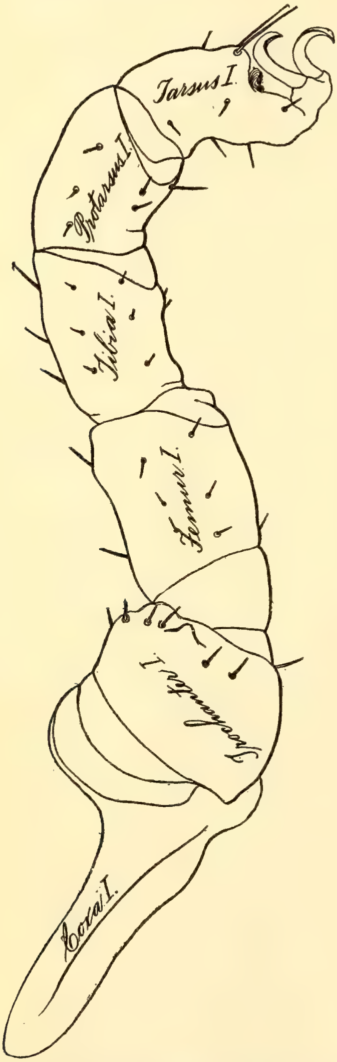


FIG. 65.—Leg I of spinose nymph of *Ornithodoros Megnini*. Greatly enlarged. Original.

A. DORSAL STRUCTURES.—On the dorsal surface are found: *Scutum* (dorsal shield), *eyes*, *dorso-submedian porose plates*, *postero-marginal festoons* and *shields*, *furrows*, *pits*, *punctations*, and *hairs*.

(1) The *scutum*, or dorsal *shield* (also called thoracic shield, dorsal plate, occasionally erroneously called the head), characteristic for the family Ixodidæ, but not found in the family Argasidæ, is a hard leather-like plate on the back. In the male (fig. 43) it usually covers the entire or almost the entire dorsal surface; in nymphs (fig. 47), it covers the anterior portion; and, on account of its size in proportion to the size of the body, nymphs are occasionally mistaken for males. In the adult female (fig. 43), it is proportionately much smaller and confined to the anterior end of the body. Usually it is more or less distinctly divided by two longitudinal *cervical grooves*, which are of some systematic importance. Its anterior portion may be more or less distinctly emarginate to receive the base of the capitulum, in which case one or two pairs of antero-terminal prolongations (fig. 60) of the scutum are present. The scutum may bear coarse or fine pores (punctations) with or without hairs; it may be quite uniform in color, or may be more or less highly colored by the presence of a *rust* of metallic luster, giving rise to various designs. The latter are subject to great variation, even among different members of the same species, and while they are often useful in *aiding* in the recognition of a species, they can not be admitted as of prime specific value. Under no circumstance, so far as can be seen at present, should these color designs alone be taken as basis for establishing new species.

(2) *Eyes* (fig. 60) are not present in all forms. When present they are visible as small, smooth, more or less semiglobular structures, one on each lateral margin of the dorsal shield in the case of Ixodidæ; or punctiform structures on the supracoxal fold near coxæ I, in the Argasidæ.

(3) The *dorso-submedian porose plates* (fig. 61).—It is not yet determined how generally these are found in different forms, but we have observed them in the genera *Dermacentor*,[1] *Rhipicephalus*,[2] *Boophilus*,[3] and *Hyalomma*.[4] They are small circular or oval chitinous structures situated one on each side of the median line near the planes of legs III and IV. Examined under a high power, they are seen to be composed much like the stigmata of a ring which incloses a number of wart-like elevations, each of which bears on its summit an elongate pore. The function of these structures is not determined. They occur in both sexes.

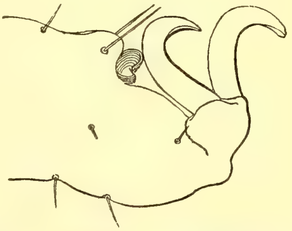


FIG. 66.—Tarsus I of *Ornithodoros Megnini* with sense organ. Greatly enlarged. Original.

(4) The *postero-marginal festoons* (fig. 169) are not present in all forms. When present, eleven may usually be more or less distinctly recognized.

(5) The *dorsal furrows* (fig. 43) run longitudinally and are due to the insertion and contraction of the dorso-ventral muscles. They are not always distinct, changing with the repletion of the tick and with the muscular contractions. They are described in great detail by some authors, who apparently attach considerable importance to their arrangement.

(6) *Pits*, *punctations*, *hairs*, *spines*.—If a microtome section is made through the cuticle of the tick, it will be seen that the tegument is pierced by numerous pores, at the base of which are situated large, peculiar gland cells, and from which issue hairs. On a surface view these pores are seen as circular bodies of various sizes, and the hairs or spines may be easily distinguished by means of a good hand lens.

B. VENTRAL STRUCTURES.—On the ventral surface are found: *Genital pore*, *anus* with *anal valve*, *anal shields*, *ventral shields*, *stigmata*, *furrows*, or *grooves*, *legs*, *pits*, *punctations*, and *hairs*.

(1) The *genital pore* (fig. 62) is situated in the ventro-median line. It is a transverse slit, more or less anterior, between the bases (coxæ) of the first three pairs of legs. It is not present in the hexapod larvæ.

(2) The *anus* (fig. 62), surrounded by a chitinous anal valve, is in the ventro-median line, posterior of the last pair of legs.

---

[1] *Dermacentor reticulatus; D. variegatus; D. electus;* and *D. nitens.*

[2] *Rhipicephalus sanguineus; R. bursa.*

[3] *Boophilus annulatus; B. australis.*

[4] *Hyalomma ægyptium.*

(3) The *anal shields*, or *plates* (clypei), (fig. 62) are present only in the male of certain genera. They are elongate in form, four in number, and are lateral of the anus. Certain forms (*Ixodes*) also have other *ventral shields*.

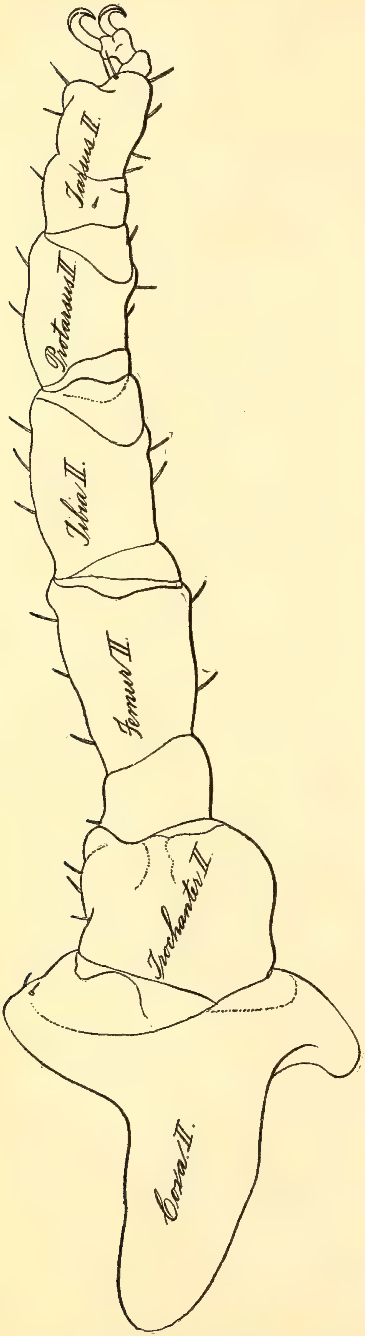


FIG. 67.—Tarsus II of spinose nymph of *Ornithodoros Megnini*. Greatly enlarged. Original.

(4) The *stigmata* (stigmal plates, or peritremes) are two in number (fig. 62), lateral or slightly ventral, one on each side of the body. In the Argasidæ they are between the III and IV pairs of legs; in the octopod stages of the Ixodidæ they are back of the IV pair of legs. It is usually stated that they are not present in the hexapod stage, but in certain forms (as in *Boophilus annulatus*) they are present (fig. 62), being situated between coxæ II and III. We have frequently found larval ticks which presented three pairs of stigma-like structures: One pair between coxæ I and II; a second pair between coxæ II and III; and a third pair, which appears to be either double or to be close to an unusually prominent chitinous ring, posterior to coxæ III.

The stigmal plates vary in form and structure in the different species and are important systematic characters. We may recognize the entire structure as the *stigmal plate*, or peritreme, with a *stigmal surface*, with an opening known as the *stigmal aperture*, or *spiracle*.

(5) *Furrows* and *grooves*.—Various furrows or grooves (fig. 62) may be recognized on the ventral surface. The most important of these are a pair of *genital furrows* and the *anal furrow*. The former extend, one on each side of the median line, from the region of the genital pore backward, diverging back of coxæ IV, and ending near the postero-lateral margins.

(6) *Pits, pores, punctations, hairs, and spines.*—(See p. 395, under "Dorsal structures.")

(7) *Caudal appendage.*—In some species, as in *Boophilus australis* (fig. 62), a distinct chitinous caudal prolongation is present.

(8) *Legs.*—The legs (fig. 68) are eight in number in the nymphs and the adult males and females (octopod forms), and six in the larvæ (hexapod form). They are arranged in pairs, which are numbered I to IV. They are composed of six *articles* united by *articulations.* By the formation of *pseudo-articulations* the third article (*femur*) and the sixth article (*tarsus*) may divide into double articles, thus giving eight to the entire leg. The various articles are named as follows, beginning at the end near the body:

First article, or *coxa*, which lies flat on the body and is not movable; in some forms it develops into large plaques, or shields. It may be provided with more or less prominent *spurs*, or *teeth* (fig. 62), in which case it is often spoken of as *dentate*, *bidentate*, etc.

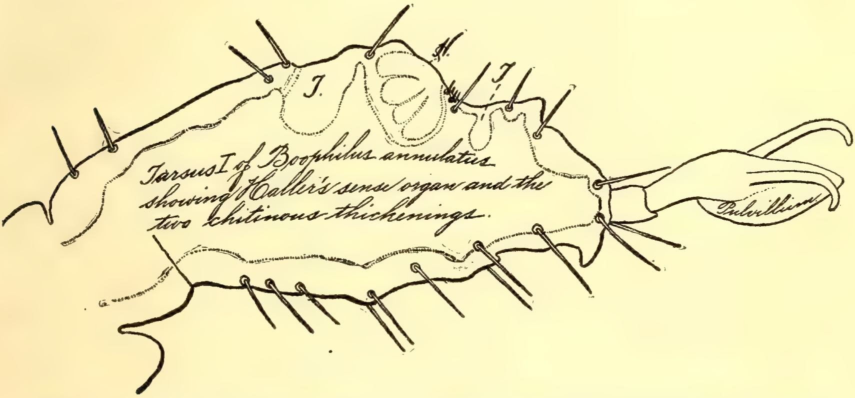

H.
T.
T
Tarsus I of Boophilus annulatus showing Haller's sense organ and the two chitinous thickenings.
Pulvillum

FIG. 68.—Tarsus I, claws and pulvillum of *Boophilus annulatus.* Greatly enlarged. Original.

Second article, or *trochanter*, a short article, may be broader than long.

Third article, or *femur*, an elongate article, which by the formation of a pseudo-articulation (at its proximal end, nearest the trochanter), may present a double article.

Fourth article, or *tibia*, elongate.

Fifth article, or *protarsus*, elongate.

Sixth article, or *tarsus*, which may form a pseudo-articulation at its proximal or at its distal end; it is the article the furthest removed from the body and bears at its distal extremity a stalk with two claws, which in the family Ixodidæ bear on their ventral surface an umbrella-like or disk-like membranous expansion known as the *pulvillum.*

The tarsi of the first pair of legs are also provided near their distal extremity with a cupuliform sense organ, *Haller's organ*, which is supposed to be an organ of hearing (fig. 68).

The corresponding articles of the different pairs of legs are numbered the same as the legs, coxæ I to IV, tarsi I to IV, etc., meaning the coxæ or tarsi of the first, second, third, or fourth pair of legs, respectively.

THE LIFE HISTORY OF TICKS.

Ticks are temporary parasites, attacking mammals, birds, and reptiles. They do not appear to be so strictly confined to certain hosts as do parasites in general. Still, this may be more of an apparent than a real rule. Certain it is that, although a given tick may be found occasionally on animals which are very dissimilar (dog ticks have, for instance, been found on snakes), still the various species show a decided predilection for certain hosts.

The parasites copulate during the period of parasitism, and suck the blood from their hosts. The female grows to a large size and eventually drops to the ground and lays numerous eggs, which are usually more or less clustered together. The larva upon hatching possesses three pairs of legs, the fourth pair being added during a molt. Either the hexapod or the octopod form may attack its host.

In case of the Texas fever tick the details of the moltings have been established by Curtice (1892, pp. 238, 239–241) as follows:

> The following table will serve to illustrate the sequence of events in the experiment and present it in rough but compact form:

Date.	Stage of experiment.	Time consumed in various stages.
1889.		
Oct. 3	Egg laying begun	
Oct. 10	Egg laying finished	Ovipositing one week.
Nov. 4	Ticks appeared	Hatching, three and four weeks.
Nov. 15	Rearing begun	Unnecessary interval of one week.
Nov. 22	First molt, larva to nymph	Larval stage lasted one week.
Nov. 29	Second molt, nymph to adult	Lasted one week.
Dec. 11	Female half grown with male	About two weeks later.
Dec. 16	Experiment closed	About one week.
	Experiment endured	About two and one-half months.

> Having briefly reviewed the experiment we may now study its products.
>
> The eggs were laid in a little mass; were subovid, dark brown and opaque, and coated with some protective substance. In alcohol they show a thin shell-like covering with a dark opaque mass within. In the latter stages of incubation the form of the young ticks became more and more apparent until they emerged. The exit from the shell seemed to be by the shell rupturing and the imprisoned occupant thrusting it off with its feet. The torn edges afterward rolled inward and produced the appearance of clam shells, so frequently mentioned in writings on this subject.
>
> * * * * * * *
>
> The young ticks, or larvæ, when they emerge are whitish, they gradually turn to chestnut brown and resemble minute seeds. Though I have never seen the seed ticks of the South since I have begun to study them from a standpoint other than to rid myself of them, I think that the young of the cattle tick may form a large portion of them.
>
> The date of the first collection, November 22, was a week from the time the young ticks were put on the calf, and very fortunately coincided with the time of the first

molt. Specimens were taken which showed the tick nearly ready to emerge from the old skin, through which they could be seen. The larva (Mégnin) is six-footed, possesses no sexual organs, and wants the large single stigmata found in later stages. I think it breathes through the six stigmata-like dots I have observed on the sides just behind each pair of limbs, but I have not yet made all the sections and examinations necessary to sustain this point. The digestive and urinary tracts and cloacal pore are present, and apparently vary little in the successive stages.

The next, or nymphal, stage, as seen through the skin of the larva, has added a pair of limbs behind the others and a pair of large stigmata behind them. The additional legs lie along the sides in a loop with its convexity directed caudally. The contents of the three front pairs of legs have withdrawn until only their white tips remain in the testa about to be molted. The head itself is withdrawn from the external skin and the mouth parts seem to be entirely disconnected from it.

Molting in this stage is completed by the testa first splitting along the side in the vicinity of the head, the feet being thrust out through it, and the dorsal and ventral halves torn apart by the force of the limbs. Specimens of the loose valves and a tick with its feet thrust through the slit near the head, which are now in the Bureau collection, demonstrate this satisfactorily.

In the change from the larval to the nymphal stage there is a complete ecdysis, accompanied by the addition of new parts. The change is therefore incomparable to the stage of metamorphosis in insects, and the terms *larva* and *nymph* can only be used in a restricted sense as applied to these stages as being analogous, but not homologous, with those stages bearing the same names among the insects. The important changes at this molt occur in the locomotory and respiratory organs.

The next specimens were collected a week later, on November 29. The collection contained individuals about to change from the nymphal to the adult stage, which, like the others, could also be seen through the testa they were about to shed. I had previously been enabled to study this stage from field collections, but the specimens collected at this time were invaluable in completing the life history of the ticks as learned from a single brood.

The molting at this period is complete. The limbs and head are withdrawn a little from the old testa. The valves split along the sides as in the earlier molt. The digestive and respiratory and locomotory organs undergo little if any modifications. The greatest change occurs in the reproductive organs, which have developed during the nymphal stage and assume their functions immediately after theecdysis, when the genital orifices appear in the new skin. Beyond this and the more decided adult characters offered in conformation there seem to be no essential changes.

The differences between the ticks destined to become either male or female during their final molt is not marked. The average of the males is smaller, but a small female may not be any larger than an ordinary male. In each the mouth ring and mouth parts, the shield-like headpiece, the breathing pores, the limbs, and the body are alike.

After they emerge, however, the males can be quickly chosen by their smaller size, by the absence of a well-defined head shield, by the extension of the shield over entire back, and by the two pairs of triangular chitinous plates, situated on the abdomen, behind and on each side of the anus. The female looks much as in her earlier stage; the head shield is, however, larger and stronger, the lines made by the muscular attachments to the body walls are stronger and deeper, and the breathing pores are much enlarged. The limbs in both male and female are strong and large as compared with their bodies, and fit them for retaining their place on their host until they have gained a new attachment by their mouth or rostrum. The external genitals which appear in the adults are very similar in each sex and occur between the bases of the second pair of legs. They present little more than an opening situated on the median line of the belly.

Throughout life the male enlarges but little; he becomes a little broader, longer, and thicker, but not markedly so. The female, on the contrary, grows to a comparatively immense size, swelling day by day, her body becoming so rotund and replete with the food drawn from her host that she can scarcely be recognized as of the same species as the males. While her body has inflated, however, her head, legs, and breathing pores have not undergone any changes. These remain exactly of the same size as in the beginning, and with the exception of the head shield are but little different from those of the male. The disparity in size between the legs and the body of the fully gorged female is so marked that the legs and head appear even smaller than at first. The comparatively small size of the male has caused it to be overlooked, or, if found, caused it to be classed among the young of this species.

After molting, the young female again attaches herself to her host, and seems rarely to change her position. While she may be able to do so at first with ease, she becomes so heavy and logy later on that any change would cause her to fall to the ground should she loosen her hold with her beak. The males, however, remain small and light, and it is not impossible for them to change their position, and no doubt do so. After molting they hunt for mates through the dense growth of cattle hairs and, finding them, attach to their host so that they can conveniently embrace them belly to belly, and bring their external genitals in apposition. In this position the males may be found with females of all sizes. That the attachment of the male to the host is for food, as well as to facilitate copulation, there can be but little doubt, for his long continuance of life, his increase in size, and the tremendous drain upon the little fellow in fertilizing the eggs demand it.

Lounsbury (1900) has given a detailed account of a closely allied form, *Boophilus decoloratus*, found in South Africa. This account is reprinted on pages 435–437 of this article.

Family Argasidæ[1] CANESTRINI, 1892.

FAMILY DIAGNOSIS.—*Ixodoidea:* Scutum absent. Capitulum inferior (except in hexapod stage, where it is antero-terminal). Digit of mandibles irregularly triangular, with broad swollen base; internal apophysis more or less transverse, acute at both ends and inserted toward the middle of the digit; middle apophysis almost linear, resting on the back of the external apophysis, terminal tooth pointed outward; external apophysis elongate, nearly parallel to digit, recurved at its base and its apex, in two similar nearly parallel hooks. Palpi free, cylindrical, the four articles rather similar. Legs slightly unequal, pair II being shortest, pair IV longest; femur and tibia (except of pair I) form pseudo-articulations at a distance from proximal end about equal to their diameter; coxæ contiguous or subcontiguous; tarsi of adult without pulvillum. Dorsal and ventral plates (shields, scutum, etc.) absent. Stigmata between III and IV pairs of legs, lateral of coxæ. Genital pore median, at height of II intercoxal interval; male pore narrow, semilunar, nearly as long as broad; vulva an elongate slit, with parallel labia and nearly as broad as capitulum. Sexual dimorphism not very pronounced.

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[1] SYNONYMY AND BIBLIOGRAPHY.

1844: Fam. *Argasiden* KOCH, 1844, pp. 219, 220.—IDEM, 1847, pp. 11, 12.
1846: Fam. *Argantidæ* AGASSIZ, 1846, p. 32. [See also MARX, 1892, p. 232.]
1861: Fam. *Argasides* FÜRSTENBERG, 1861, p. 208.
1877: Subfam. *Argasidæ* MURRAY, 1877, pp. 180–184.—BERLESE, 1885, p. 131.—RILEY, 1887, p. 744.
1880: Tribe *Argasides* MÉGNIN, 1880, pp. 132–136.
1886: Tribe *Argasinés* RAILLIET, 1886, pp. 499–502.—NEUMANN, 1888, pp. 89, 95, 96.—IDEM, 1892a, pp. 93, 100, 101.
1892: Subfam. *Argasinæ* TROUESSART. 1892, pp. 38, 46, 47.—RAILLIET. 1893, pp. 704, 715–718.—NEUMANN, 1896, pp. 2–44.—WARD, 1900a, pp. 196, 197.—IDEM, 1900b, pp. 436, 437. [See also TROUESSART, 1891, p. 308; misquotation for *Argasidæ.*]
1877: Fam. *Argasini* CANESTRINI & FANZAGO, 1877, pp. 192–194.—CANESTRINI, 1891, pp. 530–536. [See also TROUESSART, 1891, p. 307.]
1892: Fam. *Argasidæ* CANESTRINI, 1892, pp. 582, 587.—MARX, 1892, pp. 232, 233, 234.—TROUESSART, 1892, p. 22.—SALMON & STILES, 1901, pp. 400–414. [See also GERSTAECKER, 1860, p. 464.—TROUESSART, 1891, pp. 297, 298.]
1892: Tribe *Argasinæ* NEUMANN, 1892b, pp. 96, 104, 105.
1892: Group *Catastomata* MARX, 1892, pp. 233, 234.—MORGAN, 1899, p. 136.
1893: Subfam. *Argasinés* RAILLIET, 1893, pp. 715–718.

Type genus.—*Argas* Latreille, 1796.

There has been considerable difference of opinion as to whether this group is more closely related to *Dermanyssus* and *Gamasus* or to *Ixodes*. At present the consensus of opinion places it nearer *Ixodes*. The majority of recent authors consider the forms in question as representing a subfamily, but it appears to us that the presence or absence of the scutum is such an important character that family rank is not too low. The position of the head as inferior in adults, the position of the stigmata, and absence of the pulvillum from the tarsi of the adult, are also important characters which distinguish the Argasidæ from the Ixodidæ.

Genus Argas[1] Latreille, 1796.

Generic diagnosis.—*Argasidæ:* Body flattened, with oval or orbicular contour; posterior end more bluntly rounded than anterior; broadest portion posterior of coxæ IV. Hood projection above capitulum spread out on the level of the dorsal surface. Lateral margins thin or a little thickened. Tegument not mammillated, but slightly roughened by irregular zigzag wrinkles or folds, which are absent only at certain points occupied by nearly circular pits; the latter are more or less numerous

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[1] Synonymy and Bibliography.

1796: *Argas* Latreille, 1796, p. 178.—Idem, 1804, p. 53; type, *Acarus reflexus*.—Idem, 1806, pp. 155, 156.—Idem, 1829, pp. 288, 289.—Idem, 1835, p. 512.—Leach, 1815, p. 397.—Risso, 1826, p. 182.—Heyden, 1826, p. 612.—Audouin, 1832, pp. 413, 414.—Sundevall (1833).—Dugès, 1834a, pp. 14, 19.—Idem, 1834c, pp. 31, 32.—Gervais, 1844, pp. 229–233.—Idem, 1847, p. 351.—Koch, 1844, p. 219.—Idem, 1847, p. 12.—Gervais & van Beneden, 1859, pp. 455, 459, 460.—Gerstaecker, 1860, p. 464.—Idem, 1863, p. 344.—Fürstenberg, 1861, p. 208.—Moquin-Tandon, 1861, pp. 304, 305.—Verrill, 1870, p. 116.—Mégnin, 1876, pp. 288, 295.—Idem, 1880, pp. 133–136, 320–322.—Conil, 1877, pp. 27, 28, 29.—Idem, 1878, p. 101.—Murray, 1877, pp. 180–182.—Canestrini & Fanzago, 1877, pp. 193, 194.—Berlese, 1885, p. 131.—Ludwig, 1886, p. 612.—Railliet, 1886, pp. 499–502.—Idem, 1893, pp. 715–718.—Neumann, 1888, pp. 89, 95, 96.—Idem, 1892a, pp. 92, 100, 101.—Idem, 1892b, pp. 96, 104, 105.—Idem, 1896, pp. 3–25.—Blanchard, 1890, pp. 329–339.—Canestrini, 1890, pp. 530, 531–536.—Idem, 1892, p. 582.—Trouessart, 1891, pp. 290, 291, 292, 293, 294, 295, 300, 305.—Idem, 1892, pp. 35, 47.—Efisio, 1892, p. 257.—Marx, 1892, pp. 233, 234.—Osborn, 1896, pp. 255, 256.—Morgan, 1899, p. 137.—Ward, 1900a, pp. 196–198.—Idem, 1900b, p. 437.—Salmon & Stiles, 1901, pp. 401–406. [Not to be confused with *Argas* Scoul., 1835, crustacean; *Arges* Hann., 1835, crustacean; *Arges* Goldf., 1839, crustacean; *Arges* Val., 1840, fish; *Argus* Boh., 1761, mollusk;

and scattered; the larger pits may form a radiating series on dorsal and ventral surfaces, a median posterior row being longest. Eyes absent.

Type species.—*Argas reflexus.*

The members of this genus are nocturnal in their habits and nourish themselves by sucking blood of mammals and birds. Neumann mentions eleven species. The most commonly known forms are—

Argas reflexus of pigeons, which occasionally attacks man.

Argas persicus, the Persian Argas, a form which attacks man and poultry.

Argas miniatus, found on poultry and reported once for cattle.

The Chicken Tick (*Argas miniatus*).[1]

(Figures 56–58, 69–81.)

Specific diagnosis.—*Argas:* Body usually quite flat and thin, much like a bedbug (*Acanthias lectularia*), but may be swollen so as to be convex both dorsally and ven-

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Argus Scop., 1777, lepidopteron; *Argus* Poli, 1795, mollusk; *Argus* Temm., 1815, bird; *Argus* Walk., 1837, arachnoid.]

1796: *Carios* Latreille, 1796, p. 177. [See also Latreille, 1806, p. 161.—Kolenati, 1857, p. 16.—Canestrini, 1890, p. 480.—Neumann, 1896, p. 19.]

1804: *Rhynchoprion* Hermann (1804, p. 69).—Treviranus, 1831, p. 188. [See also Heyden, 1826, p. 612.—Latreille, 1829, p. 288.—Canestrini, 1890, p. 531.—Trouessart, 1891, p. 290.—Railliet, 1893, p. 715.—Neumann, 1896, p. 3.] [Not to be confused with *Rhynchoprion* or *Rhyncoprion* Oken, 1815, dipteron; *Rhynchoprium* Marx, 1895, arachnoid.]

1806: *Caris* Latreille, 1806, p. 161; type, *vespertilionis* [=*Carios* renamed].—Idem, 1829, p. 290.—Risso, 1826, p. 182.—Heyden, 1826, p. 613.—Latreille, 1835, pp. 511, 512.—Gerstaecker, 1863, p. 343. [See also Audouin, 1832, p. 413.—Dugès, 1834c, p. 32.—Kolenati, 1857, pp. 15–17.—Idem, 1858, p. 4.—Murray, 1877, p. 181.—Canestrini & Fanzago, 1877, p. 184.—Haller, 1882, p. 312.—Canestrini, 1890, p. 480.—Trouessart, 1891, pp. 290, 292, 293, 294.—Neumann, 1896, p. 19.] [Not to be confused with *Caris* Fisch., 1821, col.]

1834: "*Rhyachoprion* Hermann," of Dugès, 1834c, p. 32.

1894: "*Argus* Latreille," of Francis, 1894, p. 452.

[1] Synonymy and Bibliography.

1844: *Argas miniatus* Koch, 1844, p. 219.—Idem, 1847, p. 12.—Salmon & Stiles, 1901, pp. 402–406, figs. 56–58, 69–81.

1873: *Argas americana* Packard, 1873, pp. 740, 741, fig. 68.—Riley & Howard, 1893, p. 267.

1877: *Argas americanus* Packard of Murray, 1877, p. 182.—Mégnin, 1885, p. 460.—Marx, 1892, p. 234.—Idem, 1895, p. 199, figs. 3–3k.—Hoehr, 1893, p. 348.—Riley & Howard, 1893, p. 267.—Webster, 1893, p. 149.—Howard, 1895, pp. 417, 418.—Neumann, 1896, pp. 9–12, 25, figs. 6–11.—Osborn, 1896, p. 256, pl. III, figs. 3–3k.—Woods, 1898, pp. 102, 103, figs. 20a–b.—Hart, 1899, p. 180.—Morgan, 1899, p. 137.—Ward, 1900a, p. 197, fig. 2.—Idem, 1900b, p. 437, fig. 260.—Hassall, 1900, pp. 496–500, figs. 16–22, pl. XVI, figs. 1–2. [Not "*Argas americanus* Latreille" of Ercolani (1859), p. 248; Gamgee, 1871, p. 219.] [Not "*Argas americanus* De Geer" of Mégnin, 1880, pp. 134, 135; *Acarus americanus*, see *Amblyomma americanum*.—Dolly, 1894, p. 980.] [Renamed *Argas radiatus* Railliet, 1893, p. 718.]

1893: *Argas radiatus* Railliet, 1893, p. 718 [*Argas americana* Packard, renamed]. [See also Osborn, 1896, p. 256.]

1894: "*Argus americanus*" (Packard) Francis, 1894, p. 452 (misprint for *Argas americanus*).

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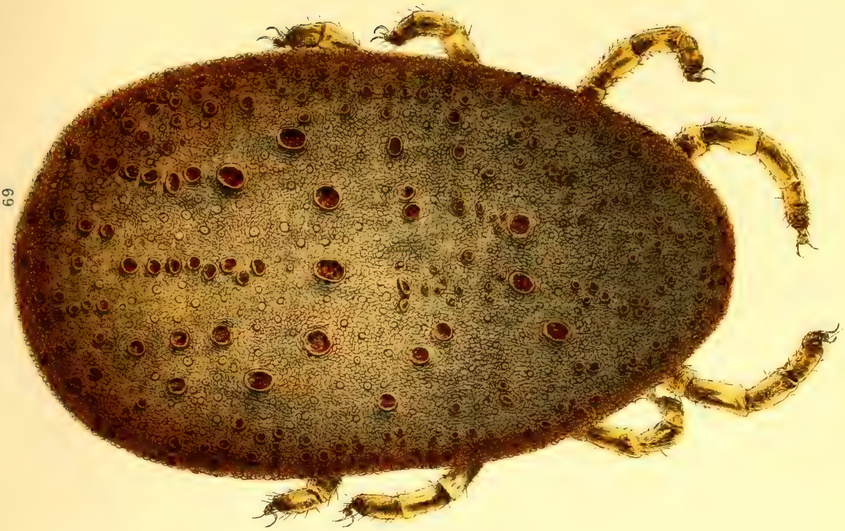

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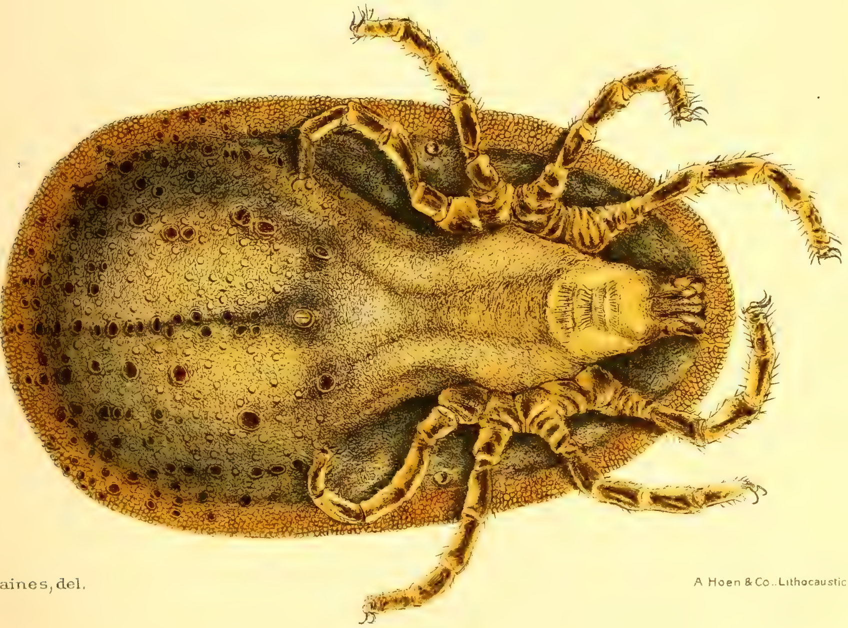

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FIG. 69. DORSAL VIEW OF ARGAS MINIATUS. AFTER HASSALL, SIXTEENTH AN. RPT. B. A. I., 1900, PL. 16, FIG. 1.

FIG. 70. VENTRAL VIEW OF SAME. AFTER HASSALL, SIXTEENTH AN. RPT. B. A. I., 1900, PL. 16, FIG. 2.

trally, the entire margin being more or less sharp; outline oval; uniform deep reddish brown, legs of lighter color. Tegument rough (shagreened), bearing short, minute, barely visible hairs; on both dorsal and ventral surface there is a marginal row of quadrangular structures, each of which is provided, more or less centrally, with a very short, bristly hair, with a broad base. Numerous glistening pits, both dorsal and ventral, arranged more or less symmetrically and usually in rows radiating from the center. The most prominent are: A semicircle each side of median line, concavity median, on dorso-anterior portion, the entire circle inclosing a slight prominence dorsal of the mouth, the two posterior pits being rather large and oval; postero-lateral of this circle a more or less parallel dorsal crescentic row; then two dorsal somewhat crescentic rows, concavity posterior; a prominent dorsomedian and ventro-median row extending from the region of the anus to posterior margin; on each side of median line, both dorsally and ventrally, five or six alternately longer and shorter rows radiating from about the transverse anal plane to the margins; two to three more or less complete marginal rows, dorsally and ventrally. Other smaller pits distributed irregularly. The arrangement of these pits is not absolutely constant. Anus about in middle of body, bordered with six to eight short bristly hairs on each side. Stigmata lateral of coxæ IV, crescentic, concavity posterior and slightly median. Mouth, legs, and genital pore on anterior half of body. Four symmetrically arranged ventral hairs directed forward on base of capitulum, two of them near the base of palpi. Coxæ contiguous, trochanters slightly broader than long; femur long, truncated

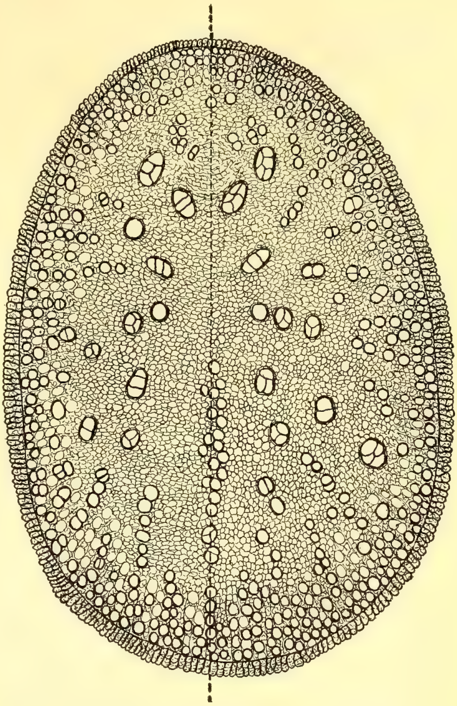

FIG. 71.—Skin of *Argas miniatus*, showing arrangement of the pits. Slightly symmetrical because of pressure. Greatly enlarged. Original.

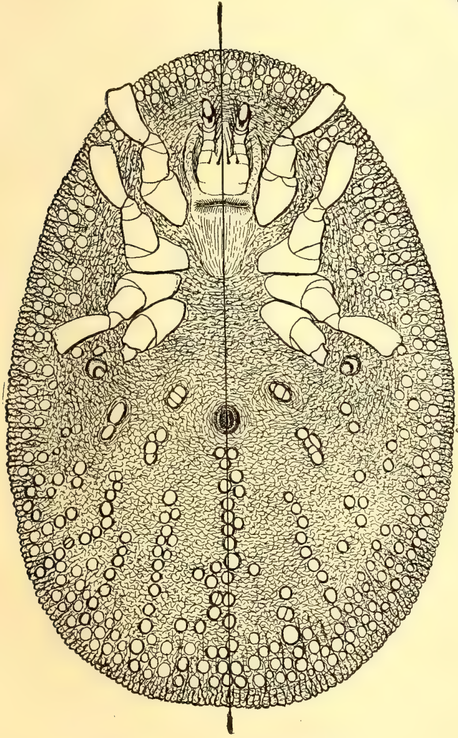

FIG. 72.—Ventral view of same.

conical, its distal extremity somewhat thicker than its proximal; tibia and protarsus cylindrical; tarsus with suddenly attenuated distal extremity and with prominent dorsal protuberance, giving it a hunch-backed appearance, especially on tarsus I; all articles except coxa with short pennate bristles, which become longer near apex of tarsus.

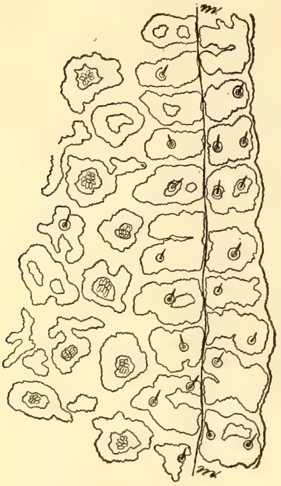

FIG. 73.—A portion of the skin of *Argas miniatus*, showing the marginal line *mm*, with the quadrate structures. Greatly enlarged. Original.

Male.—Attains 4 to 8 mm. long by 2.5 to 5 mm. broad. Capitulum 480 to 500μ broad, 0.3 mm. long from base of the palpi to tip of hypostome. Mandibles 0.9 mm. long, digit 75μ; free portion of stem 325μ; swollen base 500μ long and about 270μ broad; similar in details to *A. reflexus.* Hypostome somewhat indented at apex and bearing on each half 4 small denticles, arranged in transverse rows; then more proximally, 6 large denticles, arranged in two longitudinal rows; finally some smaller denticles, broad but not very salient, on three rows and descending two-thirds the length of the hypostome. Palpi 540 to 580μ long: First article, 120 to 164μ; second, 155 to 160μ by 140μ broad; third, 112 to 140μ; fourth, 125 to 145μ, with 8 to 14 terminal stiff bristly hairs; all articles, especially the second, bear stiff bristly hairs, most of which are slightly pennate. Genital pore narrower than the capitulum, 128 to 204μ broad.

Female.—Attains 11 mm. long by 8.5 mm. broad. Capitulum attains 670μ broad. Mandibles 1.04 mm. long, digit 80μ; stem 352μ; swollen base, 598 by 320μ. Hypostome as in male. Palpi: First article, nearly square, 160μ long; second article, 196 by 128μ; third, 160 by 112μ; fourth, 160 by 96μ; 8 to 9 short, stiff terminal hairs on the fourth article; hairs on surface of all articles, especially the second. Genital pore broader than capitulum (960:670), between coxæ I and II.

Hexapod embryo measures 680 to 768μ in length, exclusive of capitulum, and about the same in breadth; the capitulum is slightly subterminal, but its appendage and a slight portion of the base extend out prominently beyond the anterior margin of the body. Dorsally and ventrally the cuticle is much wrinkled, the lines extending for the greater part transversely; in the middle of the back there is a circular to oval area without wrinkles. Dorsal and ventral surfaces, also the articles of legs and palpi, are provided with pennate hairs, the most prominent being a ventral row near posterior margin of body. Base of capitulum (ventral view), 192μ long by 208μ broad anteriorly, 160μ broad posteriorly. Hypostome 144μ long, distinctly composed of two halves closely united in median line, its tip provided ventrally with several transverse slightly irregular minute denticles; these are followed proximally by larger denticles arranged first in three, then in two longitudinal rows, the teeth of the lateral (marginal) row being strongest, seven in number, and extending to the base; inner row smaller, may also extend to the base. Mandibles 304 to 334μ long; digit 44μ, inner apophysis biden-

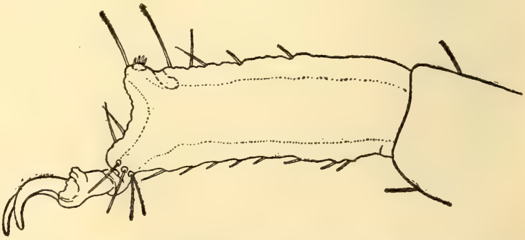

FIG. 74.—Tarsus I of adult *Argas miniatus*, showing two sense organs on tuberosity. Greatly enlarged. Original.

tate, with rather circular base, outer apophysis bidentate, middle apophysis very minute; narrow stem of mandibles 145μ long; swollen base, 145μ long by 72μ broad. Palpi 258μ long, fourth article longest (100μ) and provided with six or seven terminal hairs. Coxæ contiguous,[1] legs I and III being equally long, II slightly shorter; claws furnished with distinct pad.[2]

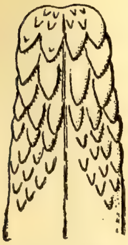

FIG. 76.—Hypostome of male *Argas miniatus.* After Neumann, 1896, p. 10, fig. 10.

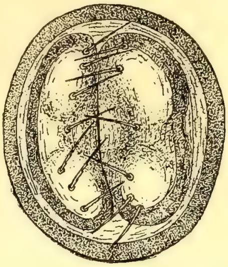

FIG. 75.—Anus of *Argas miniatus.* Greatly enlarged. Original.

This tick has been reported or sent to the Department of Agriculture a number of times from Texas and Florida, where it is claimed to do serious damage to chickens. So far as we know, it has been reported only once for cattle, Packard having found it among a number of specimens of *Boophilus annulatus* taken from cattle. We have seen one case from Florida in which a chicken was literally covered with the hexapod stage.

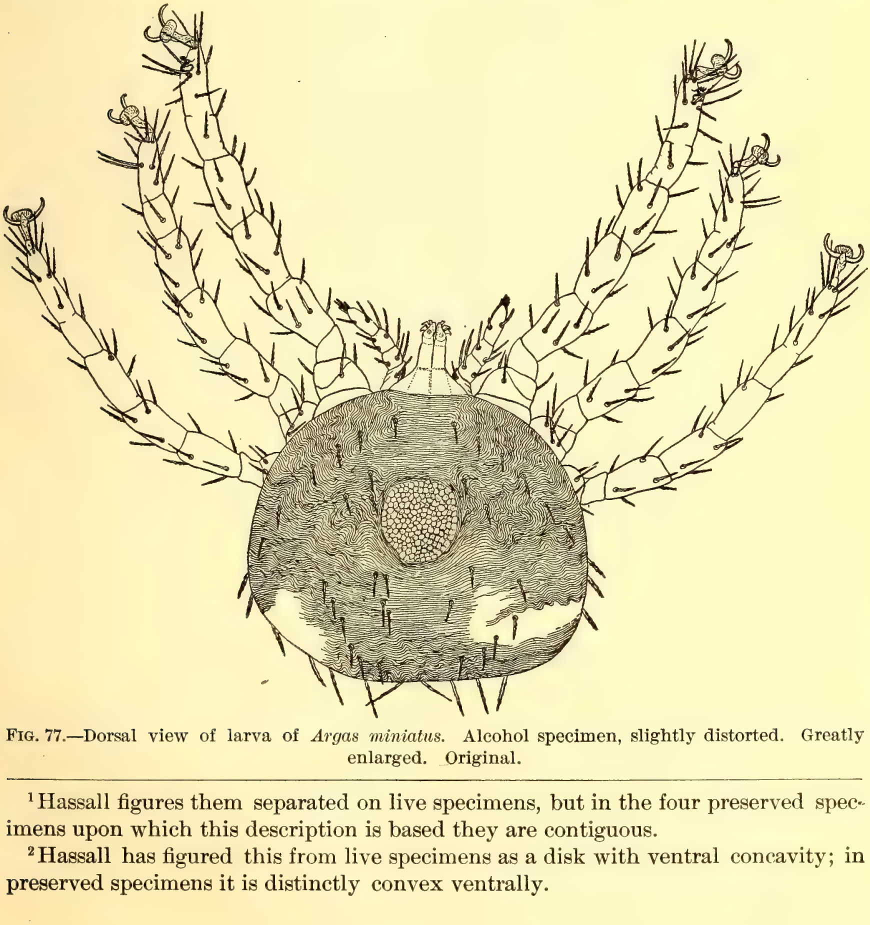

FIG. 77.—Dorsal view of larva of *Argas miniatus.* Alcohol specimen, slightly distorted. Greatly enlarged. Original.

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[1] Hassall figures them separated on live specimens, but in the four preserved specimens upon which this description is based they are contiguous.

[2] Hassall has figured this from live specimens as a disk with ventral concavity; in preserved specimens it is distinctly convex ventrally.

Regarding the technical name of this species an unfortunate confusion has arisen. When Packard proposed the name "*Argas americana*" in 1873, he overlooked the fact that Ercolani in 1859 had adopted the name "*Argas americanus* Latreille" for a form which is parasitic on the ears of horses in San Domingo. In 1871, Gamgee also referred to the same form as "*Argas americanus.*" Furthermore, it appears that in 1804, *Amblyomma americanum* was placed in the genus *Rhynchoprion* by Hermann as "*Rhynchoprion americanum.*" *Rhynchoprion*, however, is a synonym of *Argas*, and this combination would therefore invalidate the name "*Argas americana* Packard, 1873." In view of the facts just stated, Railliet changed the name of the chicken tick to *Argas radiatus*, but Neumann has recently reexamined the types of Koch's *A. miniatus* from French Guiana and pronounced them identical with this species. *A. Sanchezi* is also probably identical with the chicken tick.

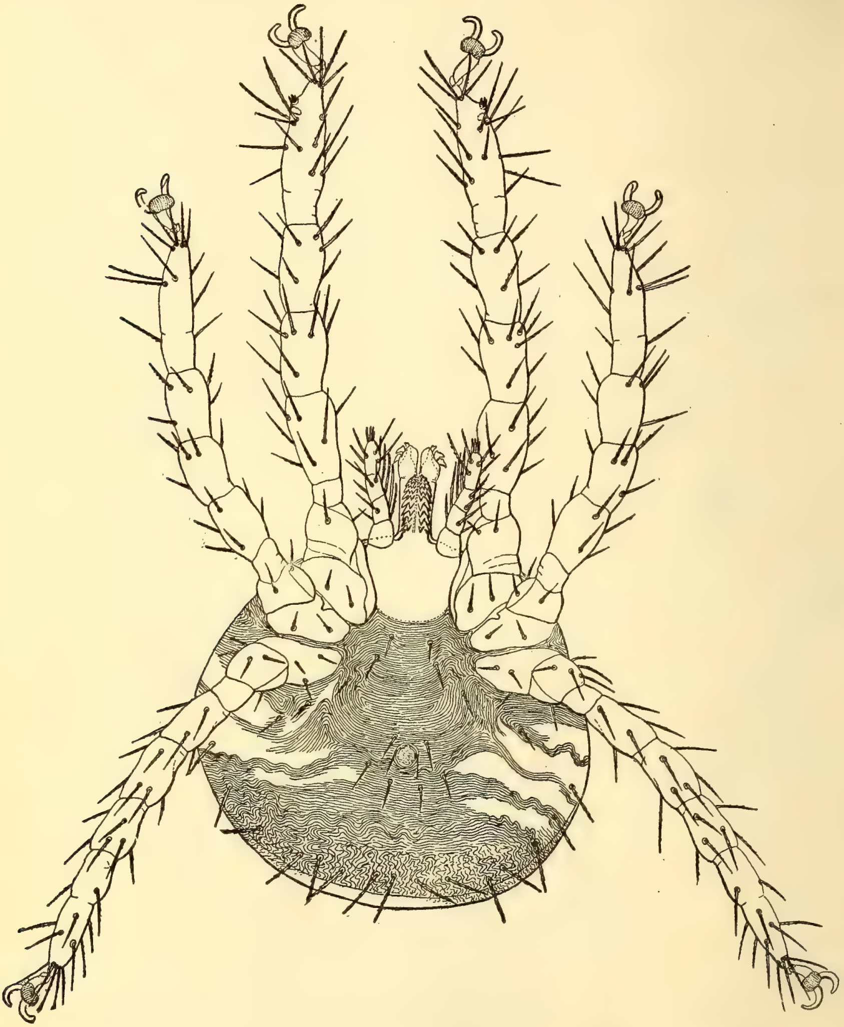

FIG. 78.—Ventral view of larva of *Argas miniatus*. Greatly enlarged. Original.

GENUS ORNITHODOROS[1] Koch, 1844.

GENERIC DIAGNOSIS.—*Argasidæ:* Body sometimes oval, lateral borders generally straight or almost straight and parallel, occasionally concave; anterior end more or less pointed, the sides diverging from here backward to the insertion of the II pair of legs; posterior end rounded. Hood recurved ventrally, where it is hollowed out to form a so-called "camerostome" with thick edge. Margins of body thick, with undifferentiated tegument. Tegument mammillated with hemispherical elevations of various designs; on the dorsal surface variable depressions; on the ventral surface more or less constant folds and grooves; two paired longitudinal projecting folds (coxal folds) near median border of coxæ, disappearing posterior of coxæ IV; a pair of similar folds (supercoxal folds) above and lateral of coxæ; one transverse preanal furrow; one transverse postanal furrow; one longitudinal anal groove extending from anus to postanal groove. Eyes present or absent.

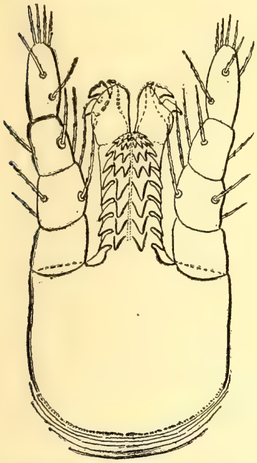

FIG. 79.—Capitulum of larva of *Argas miniatus.* Ventral view. Greatly enlarged. Original.

TYPE SPECIES.—*O. Savignyi* (Audouin, 1827) KOCH, 1844.

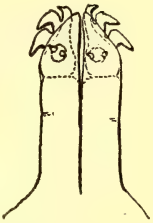

FIG. 80.—Dorsal view of mandibles of same. Greatly enlarged. Original.

Neumann cites ten species for this genus. The best-known forms are—

- *Ornithodoros Savignyi*, an African form which attacks man and animals and is alleged to produce quite serious effects.
- *O. turicata*, an American form (South America, Mexico, southern United States) which attacks hogs and man, with alleged occasional fatal results.
- *O. Megnini*, the spinose ear tick which attacks cattle, horses, asses, dogs, sheep, and man.

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[1] SYNONYMY AND BIBLIOGRAPHY.

1844: *Ornithodoros* KOCH, 1844, p. 219.—IDEM, 1847, pp. 11–12.—FÜRSTENBERG, 1861, p. 208.—CANESTRINI, 1890, p. 531.—IDEM, 1892, p. 582.—TROUESSART, 1892, p. 47.—NEUMANN, 1896, pp. 3, 25–44.—LOUNSBURY, 1899, p. 240.—WARD, 1900a, pp. 196–198.—IDEM, 1900b, p. 437.—SALMON & STILES, 1901, pp. 407–414. [See also CANESTRINI & FANZAGO, 1877, p. 194.]

1877: *Argas* (*Ornithodoros*) in MURRAY, 1877, p. 183.

1878: "*Ornithodorus* Koch" of KARSCH, 1878, p. 321.—MARX, 1892, pp. 233, 234.—IDEM, 1895, p. 199.—OSBORN, 1896, p. 255.—MORGAN, 1899, p. 137.

1895: *Rhynchoprium* MARX, 1895, p. 199; type, *spinosum.*—OSBORN, 1896, p. 255. [See also NEUMANN, 1896, p. 42.] [Not to be confused with *Rhynchoprion* HERMANN, 1804, arachnoid; OKEN, 1814, dipteron.]

1899: "*Ornithodorous* Koch" of MORGAN, 1899, p. 136.

THE SPINOSE EAR TICK (*Ornithodoros Megnini*).[1]

(Figures 65–67, 82–108.)

SPECIFIC DIAGNOSIS.—*Ornithodoros: Adult.*—Body phial-shaped; slightly attenuated anteriorly, broadest at legs II, slightly constricted near legs IV, broadly rounded posteriorly; color brown to violet or black. On the surface, symmetrical depressions, one arciform, longitudinal, from each side of the projection corresponding to the capitulum; lateral and slightly anterior of this, an infundibuliform depression; in back, along the lateral border, a longitudinal groove of variable length, sometimes interrupted; a median groove occupying the greater length of the posterior half. Ventral surface: Preanal groove absent, replaced by a first postanal groove at a tangent to the anal slit, straight and joining the coxal groove; the true postanal groove near posterior border; a broad anal groove terminating at this postanal groove. Subcoxal and coxal folds broad, well marked, the latter not passing coxæ II, and the coxal groove passing between coxæ I and II, extending backward to the second postanal groove and disappearing on the sides near the posterior angle of the body. Stigmata circular, 250 μ in diameter, stigmal pore semilunar. Anal valve broader than long (150 to 200 μ by 200 to 250 μ), each lip provided with short hairs. Eyes absent. Tegument slightly rough (shagreened), forming an irregular mosaic, strewn with numerous fine, short hairs. Reticulate fossettes occupy the ventral and dorsal depressions; others scattered here and there.

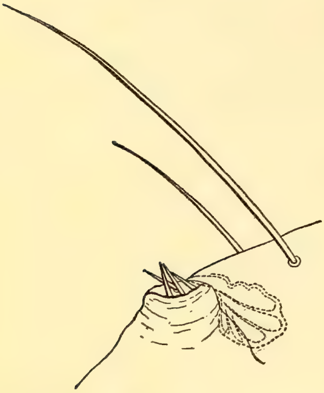

FIG. 81.—Two sense organs on tarsus I of embryo of *Argas miniatus*. Greatly enlarged. Original.

On the ventral surface between the two postanal grooves, extremely small and hard spines. Capitulum very small and short; 150 μ from base of palpi to extremity of hypostome. Maxillæ slender, 490 μ long, digit 75 μ, stalk slightly and insensibly swollen proximally. Internal apophysis of digit thick, provided with four teeth, two terminal nearly perpendicular to each other, and two intermediate, smaller; external apophysis with superior tooth slightly salient, inferior tooth large, bent backward; median tooth well developed. Hypostome blade-shaped, broad at the base, rounded at the extremity, unarmed.[2] Palpi thick, 300 μ long (90 μ, 85 μ, 65 μ, 60 μ, from first to fourth article), with articles relatively broad and short, the second

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[1] SYNONYMY AND BIBLIOGRAPHY.

1883: *Argas Megnini* DUGÈS, 1883, pp. 196, 197.—MÉGNIN, 1885, pp. 466, 472–475, pl. XXI, figs. 1–8.—NEUMANN, 1888, p. 96.—IDEM, 1892a, p. 101.—IDEM, 1892b, p. 105.—RAILLIET, 1893, p. 718.—DOLLY, 1894, p. 980. [See also NEUMANN, 1896, p. 42, as syn. of *Ornithodoros Megnini*.]

1893: "*Argas americana* Packard" of TOWNSEND, 1893, pp. 50–52.

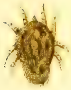
1895: *Rhynchoprium spinosum* MARX, 1895, p. 199, pl. II, figs. 1–1i.—OSBORN, 1896, pp. 255, 256, pl. III, figs. 1–1i. [See also NEUMANN, 1896, p. 42, and STILES & HASSALL, 1891, p. 1, as syn. of *Ornithodoros Megnini*.]

1896: *Ornithodoros Megnini* (Dugès) NEUMANN, 1896, pp. 42–44, figs. 36 a–b.—WARD, 1900a, p. 199, fig. 3.—STILES & HASSALL, 1901, pp. 1, 2.—SALMON & STILES, 1901, pp. 408–414, figs. 65–67, 82–108.

[2] Mégnin describes and figures teeth in five transverse rows, of which the first on each half comprises only one tooth, and the last four; none of Neumann's or our preparations corresponded to this description.

PLATE LXXIX.

82



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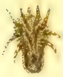

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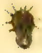

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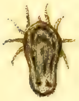

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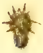

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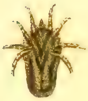

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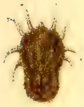

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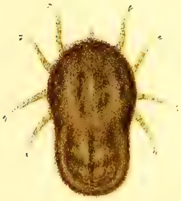

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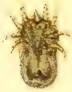

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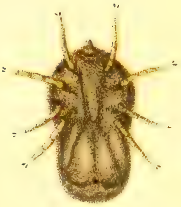

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A. Hoen & Co., Lithocaustic

FIGS. 82, 86, 90. DORSAL VIEWS OF THE SPINOSE EAR TICK (ORNITHODOROS MEGNINI). NATURAL SIZE. ORIGINAL.

FIGS. 83, 87, 91. THE SAME. X2. ORIGINAL.

FIGS. 84, 88, 92. VENTRAL VIEWS OF SAME SPECIMENS. NATURAL SIZE. ORIGINAL.

FIGS. 85, 89, 93. THE SAME. X2. ORIGINAL.

110 μ broad; on dorsal surface of the articles, especially of the first and at the dorsal base of the capitulum, in back of the insertion of the palpi, numerous pennate hairs. Two ventral hairs at the base of the capitulum. Legs thinner and a little shorter than in the nymph; coxæ as in the other members of the genus; prominent tuberosity on dorsal surface of the tarsi.

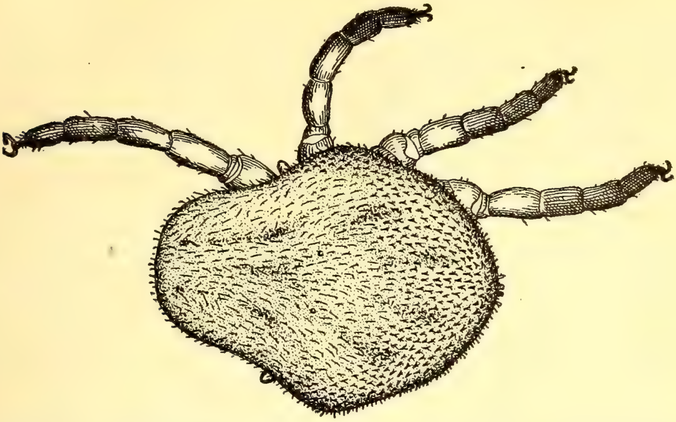

FIG. 94.—Dorsal view of spinose nymph of ear tick. Greatly enlarged. After Marx, 1895, Pl. II, fig. 1.

Dimensions.—Females, 5 to 6 mm. by 3 to 4 mm.; males somewhat smaller.

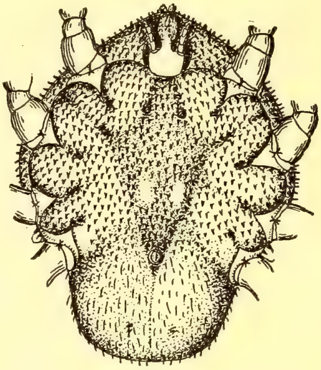

FIG. 95.—Ventral view of spinose nymph of ear tick. Greatly enlarged. After Marx, 1895, Pl. II, fig. 1a.

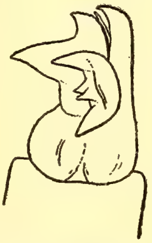

FIG. 96.—Digit of mandible of nymph. After Neumann, 1896, p. 43, fig. 36a.

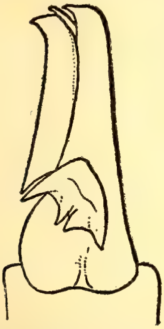

FIG. 97.—Digit of mandible of adult. After Neumann, 1896, p. 43, fig. 36b.

Nymph.—Body somewhat longer than broad, greatest breadth at about III pair of legs, anterior of this the outline is bluntly rounded; posteriorly, suddenly contracted at IV pair of legs; may attain 3 to 8 mm. in length and 2 to 5.5 mm. in breadth. Tegument thickly beset with spines anteriorly, and bristly hairs posteriorly; the former occupy a crescentic band dorsally, the horns of the crescent extending to legs III or IV, but ventrally the spines extend to or slightly beyond the anus. Stigmata on salient tubercles, 300 to 350 μ in diameter. Anus very small, slightly broader (110 to 120 μ) than long. Capitulum subterminal in young, inferior in older individuals, elongate, base as long as palpi; about 375 μ from base of palpi to tip of hypostome. Mandibles 760 μ, digit 85 μ, base scarcely swollen posteriorly; internal apophysis of digit strong, with four teeth, two external and terminal, two small and intermediate; external apophysis with long, strong poster-posterior teeth; median apophysis normal. Hypostome lanceolate, each half with four rows of seven to nine strong alternating teeth, the teeth of the median row on each half on same transverse planes. Palpi thick, 455 μ long (140 μ, 125 μ, 110 μ, 180 μ, from first to fourth article); second article 110 μ broad; hairs not very numerous on last three articles, six to eight short terminal bristles. Legs long and strong; coxæ very short, but broad, almost marginal; other articles cylindrical, relatively short compared with their diameter; ventro-terminal portion of tarsi elongate, claws strong, pulvillum absent.

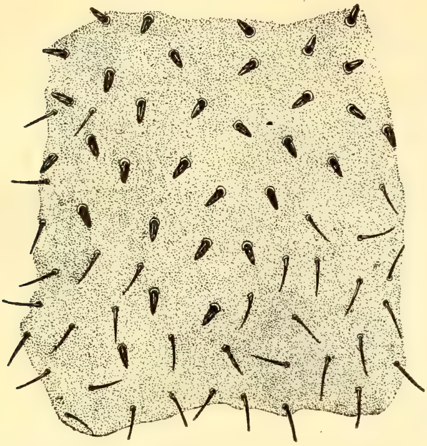

FIG. 98.—Portion of skin, showing spines and hairs. Greatly enlarged. Original.

Hexapod larva.—The hexapod larva is elongate oval, with long terminal capitulum, measuring 0.61 mm. from tip of hypostome to posterior extremity. The tegument is finely striated, and pierced with symmetrically arranged pores, from which bristle-like hairs issue. The palpi and hypostome are of practically equal length; hypostome with two rows of denticles on each half; palpi, first article short, second and third long and equal, fourth short. Between coxæ I and II, and II and III, are found minute spiracle-like[1] structures in the cuticle. On the claws is found a small pulvillum-like pad.

Some of our specimens of this species show a pupa-like stage. They are about 4 mm. long by about 2 mm. broad, rounded white pyriform structures with one end elongate. Closer examination shows the outer covering to be a smooth, cast skin; the cast hypostome has two rows of denticles; three pairs of legs are present, pair I larger and longer than II and III. Inside of this distended smooth hexapod skin with terminal capitulum is found the spinose octopod form with subterminal capitulum, and with well-developed claws on the tarsi, and four rows of denticles on each half of the hypostome.

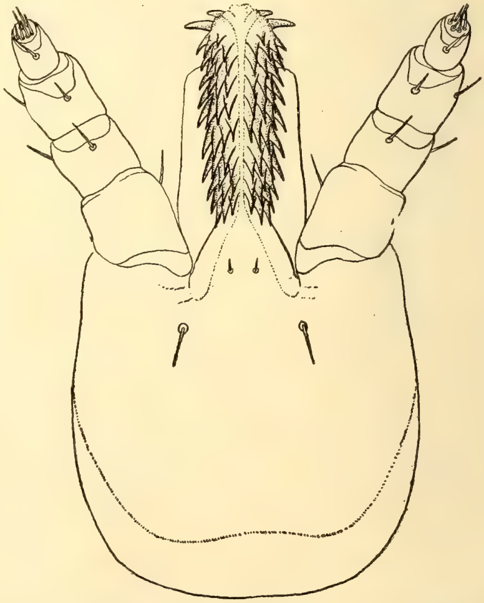

FIG. 99.—Ventral view of capitulum of same. Original. Greatly enlarged.

We have not seen this stage alive, but from the general structure it is apparent that in changing from the hexapod to the octopod stage *O. Megnini* passes a resting pupa-like stage. This is by no means surprising, since the differences between the hexapod and the octopod stages of the Argasidæ are far greater than those between the corresponding stages of the Ixodidæ. This is apparently the stage which Townsend (1893) interpreted as an egg.

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[1] Whether these structures are actually stigmata and pulvilli remains to be determined when fresh material can be obtained.

The specimens in question were taken on post-mortem examination from the ear of cattle in San Dimas, Cal., by Mr. M. L. Eckels, and sent with other stages of the same tick to this laboratory for determination.

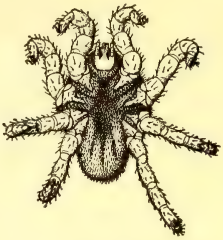

FIG. 100.—Ear tick after shedding the nymph skin. Greatly enlarged. Original.

This tick is remarkable for the difference in appearance between the young spiney stage and the adult form, a difference that is so great that the two stages have been described as belonging to different species.

The ear tick has been reported to this Bureau a number of times, notably from Texas, New Mexico, California, Kansas, and Nebraska. It was originally described from Mexico by Dugès, who gave the following account of it:

> *Argas Megnini* Alf. Dug.[1]—This epizoon, very abundant in the State of Guanajuato, is found on the horse, the ass, and the ox, principally in the ears, and is spread frequently to other animals, in particular to man, for I have often removed it from the ear passage of children, and even of adults.
>
> The body of the Garrapata, wider anteriorly than posteriorly, in the shape of a guitar, is less depressed than that of the Turicata. It is covered with little horny spines, the color of mahogany, surrounded by a border at the base; the general color is lead color, with legs of deep yellow. The male, very small compared with the female, and yellowish when it is fasting, has large legs comparatively, the largest being those of the pair IV. The legs are more robust than those of the Turicata,

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[1] *Argas Megnini* Alf. Dug.—Este epzoario, abundantísimo en el Estado de Guanajuato, se halla sobre el caballo, el asno y el buey, principalmente dentro de las orejas, y se pega con frecuencia á otros animales, en particular al hombre, pués no pocas veces lo he extirpado del conducto auricular de niños y aun de adultos.

El cuerpo de la garrapata, más ancho hácia adelante que hácia atrás, en forma de guitarra (panduriforme), es ménos deprimido que el de la Turicata; está cubierto de pequeñas espinas córneas (v. fig. 1), color de coaba, circundados por un rodete en la base (fig. 4); el color general es aplomado, con las patas de un aleonado bajo. El macho (fig. 3), muy chico respecto á la hembra, y amarilloso cuando está en ayunas, tiene las patas más largas respectivamente, siendo más grandes las del cuarto par. Las patas (fig. 5) son más robustas que de la Turicata, apartadas una de otra (fig. 2), y con dificultad se distinguen las ancas; hay dos espinitas debajo del último artículo. Las piezas bucales salen de un repulgo circular; las maxilas tienen en la extremidad dos laminas bidentadas (fig. 8, a) y la lengüeta (fig. 8, b) está provista de dientes dirigidos hácia atrás y más agudas en el macho que en la hembra.

Como se ve por esta breve descripción, puramente diferencial, no se pueden confundir las Turicatas con las Garrapatas. Parecen estas últimas ménos nocivas; á lo ménos es más fácil hacerles soltar la presa, é impedir que dejen su rostro en la herida; muchas veces basta el aceite para obligarlas á desprenderse.

separated from each other, and it is difficult to distinguish the posterior ones. There are two little spines under the last article. The mouth pieces extrude from a circular fold; the maxillæ have at the extremity two bidentate laminæ, and the hypostome is provided with teeth, directed posteriorly and much sharper in the male than in the female.

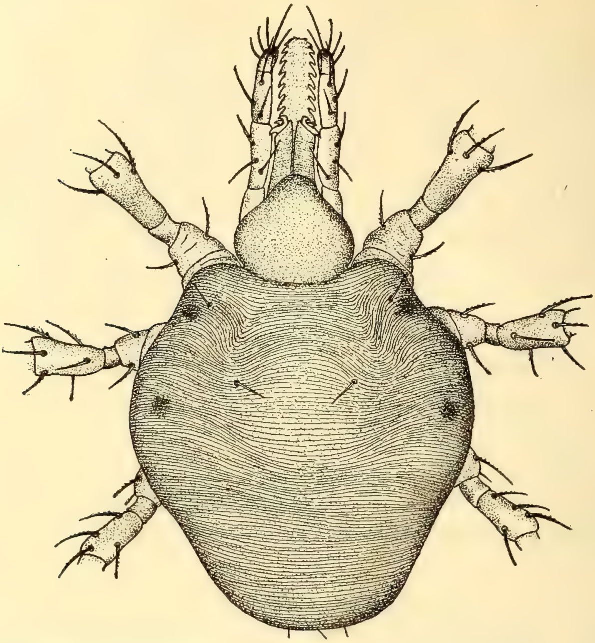

FIG. 101.—Dorsal view of hexapod larva of ear tick. Greatly enlarged. Original.

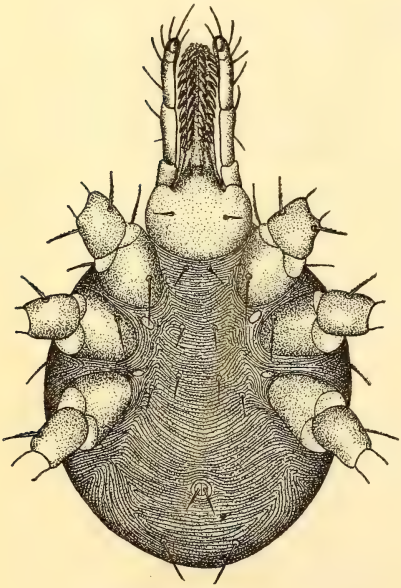

FIG. 102.—Ventral view of same. Original.

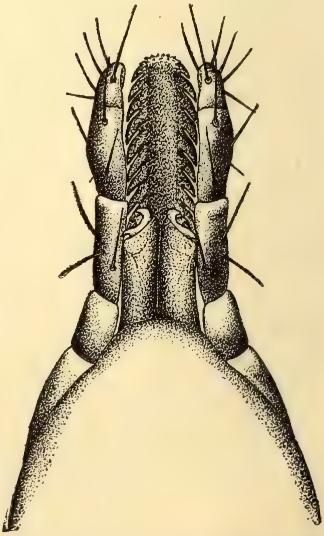

FIG. 103.—Dorsal view of capitulum of same. Greatly enlarged. Original.

As is seen from this brief, purely differential description, it is not possible to confuse the Turicatas with the Garrapatas. It seems that these latter are less noxious; at least it is easier to make them loose their hold, and to prevent their leaving the capitulum in the wound; frequently oil is sufficient to make them drop off.

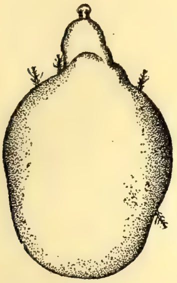

FIG. 106.—Dorsal view of resting stage between hexapod and octopod forms. Greatly enlarged. Original.

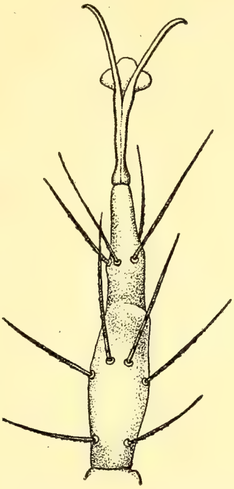

FIG. 105.—Dorsal view of same. Original.

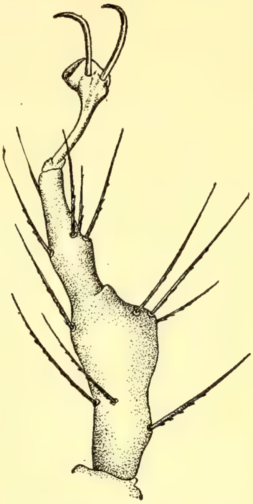

FIG. 104.—Tarsus I of same side view. Original.

Neumann examined a number of specimens collected in Mexico by Dugès, basing a detailed description upon them. This description seems to agree in essential characters with the forms we find in the United States. Neumann calls attention to the fact that the nymph is better armed than the adult and may grow to be as large. He states that he would hesitate to consider these two forms as belonging to the same species had he not found a cast nymph skin around a female. We have repeatedly followed this transformation on specimens sent to us, and can confirm beyond question the statement that the nymph and the adult are very dissimilar.

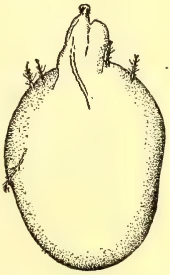

FIG. 107.—Ventral view of same. Greatly enlarged. Original.

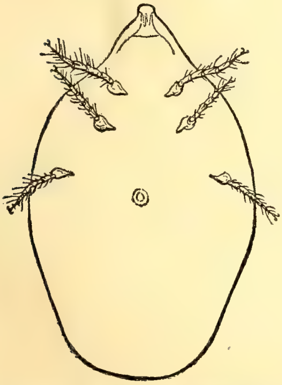

FIG. 108.—Outline of another specimen of same. Greatly enlarged. Original.

Judging from letters received by this Bureau, the ear tick is accused of causing a variety of troubles. Some correspondents report sickness and even death among cattle as having been caused by the parasite, while others are not inclined to attach so much importance to its presence.

Owing to their position in the ear, it is not possible to use any very drastic measures against them, but, as a rule, if any bland oil, such as linseed or olive oil, is poured into the ear, the ticks will soon vacate; they are not killed by this treatment, hence every tick caught should be crushed in order to prevent increase.

Family Ixodidæ[1] MURRAY, 1877.

FAMILY DIAGNOSIS.—*Ixodoidea:* Scutum present. Capitulum terminal. Digit of mandibles provided with two apophyses; internal apophysis generally short, terminated by one to four equal or unequal teeth; external apophysis elongate, parallel to digit, bearing on its free border two to five teeth, which increases in size from the distal to the proximal. Palpi free, second and third articles valvate on their median surface; fourth article very short in adult, as tactile appendage, situated in an inferoterminal depression of the third. Legs a little unequal, pair II shortest, pair IV longest; femur and tibia presenting pseudo-articulation near proximal end, except in pair I, where the pseudo-articulation is distal; tarsus with pulvillum. Stigmata posterior of the coxæ IV. Genital pore median at height of coxæ I to III; two sexual grooves extend from here posteriorly, more or less divergent, toward posterior margin. Sexual dimorphism very marked.

Male.—Usually smaller than female, flatter, often of less regularly oval contour, anterior extremity being much straighter than posterior; dorsal shield covers entire dorsal surface or all but a marginal band; posterior margin ordinarily divided into eleven quadrangular festoons, distributed between dorsal extremity of the two stigmata, and often extending under the ventral surface. These represent in some cases marginal shields, the number and form of which are often variable.

Female.—At first flat, later may become very thick, dorsal shield confined to anterior part of animal, remains comparatively small. Capitulum with two symmetrical porose areas, not found in larvæ, nymphs, or males.

TYPE GENUS.—*Ixodes* Latreille, 1796.

Most of the ticks described to date belong to this family, which may be divided into two subgroups, ranked by some authors as "families," by other authors as "tribes." The most natural course to follow is to call them subfamilies, under the names Ixodinæ and Rhipicephalinæ.

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[1] SYNONYMY AND BIBLIOGRAPHY.

1834: Fam. *Ixodei* (French *Ixodès*) DUGÈS, 1834a, pp. 14, 19–20.—IDEM, 1834c, pp. 33–35.

1859: Fam. *Ixodidès* GERVAIS & VAN BENEDEN, 1859, pp. 460, 461.

1877: Fam. *Ixodidæ* MURRAY, 1877, pp. 185–204.—CANESTRINI, 1890, p. 530.—IDEM, 1892, p. 581.—IDEM, 1897, pp. 468, 469.—TROUESSART, 1892, p. 22.—SALMON & STILES, 1901, pp. 414–478. [See also CANESTRINI, 1890, p. 482, and TROUESSART, 1891, pp. 295, 297, 302.]

1877: Fam. *Ixodini* CANESTRINI & FANZAGO, 1877, pp. 178–192.—CANESTRINI, 1890, pp. 475–529. [See also TROUESSART, 1891, p. 307.]

1880: Tribe *Ixodides* MÉGNIN, 1880, pp. 120–132.

1885: Subfam. *Ixodidæ* BERLESE, 1885, p. 131.

1886: Tribe *Ixodinés* RAILLIET, 1886, pp. 495–499.—NEUMANN, 1888, pp. 89–95.—IDEM, 1892a, pp. 93–100.

1892: Subfam. *Ixodinæ* TROUESSART, 1892, pp. 38, 47.—RAILLIET, 1893, pp. 704–714.—NEUMANN, 1896, p. 2.—IDEM, 1897, pp. 324–420.—IDEM, 1899, pp. 107–294.—WARD, 1900a, pp. 196, 199–205.—IDEM, 1900b, pp. 435–437. [See also TROUESSART, 1891, p. 307; misquotation for *Ixodidæ.*]

1892: Tribe *Ixodinæ* NEUMANN, 1892b, pp. 96–104.

1892: Group *Antistomata* MARX, 1892, pp. 234–236.

Subfamily Rhipicephalinæ[1] SALMON & STILES, 1901.

SUBFAMILY DIAGNOSIS.—*Ixodidæ:* Palpi short, more or less conical, but usually longer than the hypostome.

TYPE GENUS.—*Rhipicephalus.*

This subfamily contains the genera *Rhipicephalus*, *Boophilus*, *Hæmaphysalis*, and *Dermacentor*. (For analytical key, see p. 385.)

GENUS RHIPICEPHALUS[2] Koch, 1844.

GENERIC DIAGNOSIS.—*Rhipicephalinæ:* Eyes distinct; base of capitulum broader than long, hexagonal on dorsal surface, forming at each side a projecting angle. Palpi short, broad; third article prolonged on its dorsal surface by a short retrograde point; first article by an internal (median) lobe, occasionally not distinct, and slightly retrograde. Coxæ I with two generally large teeth. Stigmata in form of a comma, with short tail in the female, long tail in the male.

Male with two pairs of anal shields (clypei): (1) One pair of large adanal shields placed at each side of the anus, triangular or occasionally rectangular; (2) one pair of smaller shields lateral of these.

TYPE SPECIES.—*R. sanguineus* (Latreille).

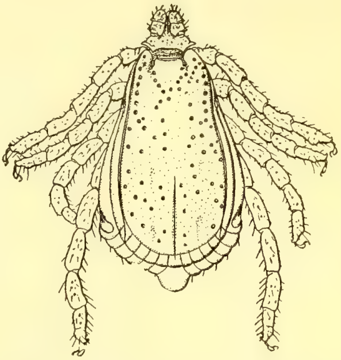

FIG. 109.—Dorsal view of an Italian male *Rhipicephalus sanguineus.* Greatly enlarged. Original.

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[1] SYNONYMY AND BIBLIOGRAPHY.

1844: Fam. *Rhipistomiden* KOCH, 1844, pp. 234–239.—IDEM, 1847, p. 24–27.
1861: Fam. *Rhipistomides* FÜRSTENBERG, 1861, p. 208.
1890: *Conipalpi* CANESTRINI, 1890, p. 491. [See also NEUMANN, 1897, p. 325.]
1892: Fam. *Rhipistomidæ* MARX, 1892, pp. 235, 236. [See also CANESTRINI, 1890, p. 482.—TROUESSART, 1891, p. 298.]
1897: Tribe *Rhipicephalæ* NEUMANN, 1897, pp. 325–420.
1901: Subfam. *Rhipicephalinæ* SALMON & STILES, 1901, pp. 415–458.

[2] SYNONYMY AND BIBLIOGRAPHY.

1844: *Rhipicephalus* KOCH, 1844, pp. 238, 239.—IDEM, 1847, pp. 26, 27.—FÜRSTENBERG, 1861, p. 208.—MURRAY, 1877, pp. 187, 200.—CANESTRINI & FANZAGO, 1877, pp. 179, 186, 190–192.—CANESTRINI, 1890, pp. 479, 483, 484, 487, 489, 490, 491, 492, 493, 513–519.—IDEM, 1892, p. 581.—TROUESSART, 1892, p. 47.—RAILLIET, 1893, p. 712.—MARX, 1892, pp. 233, 235, 236.—NEUMANN, 1897, pp. 325, 326, 384–418.—MORGAN, 1899, pp. 138, 139.—WARD, 1900a, p. 201.—SALMON & STILES, 1901, pp. 415–419.
1889: *Phauloixodes* BERLESE, 1889, fasc. LV, NOS. 7–8; type, *rufus.* [See also NEUMANN, 1897, pp. 384, 385, as syn. of *Rhipicephalus.*]
1889: *Phaulixodes* BERLESE, 1889, fasc. LV, No. 8, Taf. (misprint for *Phauloixodes*).—CANESTRINI, 1890, pp. 485, 487, 488, 490, 491, 492, 511.—NEUMANN, 1897, p. 420.
1892: "*Phautoixodes* Berlese" of MARX, 1892, p. 236.—MORGAN, 1899, p. 139.
1899: "*Rhicephalus*" in FULLER, 1899, p. 392 (misprint for *Rhipicephalus*).

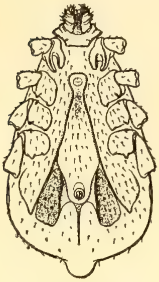
FIG. 110.—Ventral view of *Rhipicephalus sanguineus.*

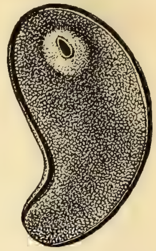
FIG. 111.—Stigmen of same. Greatly enlarged. Original.

There is some difference of opinion regarding the genus to which the Texas fever tick belongs. While it was originally placed in the genus *Ixodes* by both Say and Riley, Curtice proposed for it a new genus, *Boophilus*, and this name has been very generally adopted by American authors and even by the press. Its validity is, however, disputed. Undoubtedly the Texas fever tick does not belong in *Ixodes*, and the question is whether it should be placed in *Rhipicephalus* or be made the basis of a distinct genus, *Boophilus*. It must be admitted that *Boophilus* is by no means so clearly defined from *Rhipicephalus* as the latter is from *Dermacentor*, *Hæmaphysalis*, or *Ixodes*. On the other hand, it is to a certain extent different from the average *Rhipicephalus*. Neumann, who has examined more different species of ticks than any other author, and to whose opinion, therefore, great weight should be attached, unhesitatingly suppresses the genus *Boophilus*, not giving to it even subgeneric rank. Ward, on the other hand, inclines to look upon *Boophilus* as of generic rank, and the late Dr. Marx (1892) was of the same opinion. Our own view has been for some years that *Boophilus* should be given at least subgeneric rank under *Rhipicephalus*.

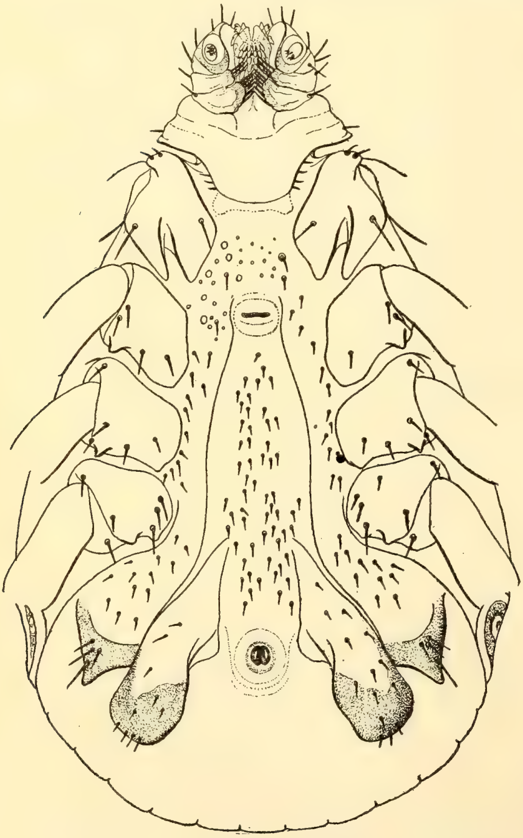
FIG. 112.—Ventral outline of an undetermined *Rhipicephalus* from a dog. Porto Rico. Original.

The point at issue is of both theoretical and practical importance. Under existing circumstances, we consider it better in the present paper to hold to the name *Boophilus*, recognizing this as a distinct genus. We are led to this conclusion, not only because of the fact that the genus *Boophilus* is not entirely unjustified, hence a change to *Rhipicephalus* at present might be only temporary, but from a practical standpoint, we prefer not to change a technical name which has become almost vernacular, unless the necessity for such change is clearly indicated. From the fact that some authors consider *Boophilus* as entirely distinct from *Rhipicephalus*, while others consider the two genera congeneric, it is evident that the question is not definitely settled. Of the two opinions the one here temporarily adopted has the advantage of coinciding with the more generally used name, and in matters of public hygiene, where others besides zoologists are concerned, it is necessary to take this into consideration, unless popular vernacular is directly contradicted by technical facts.

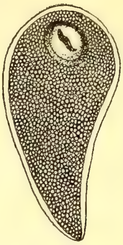

FIG. 113.—Stigmen of same. Greatly enlarged. Original.

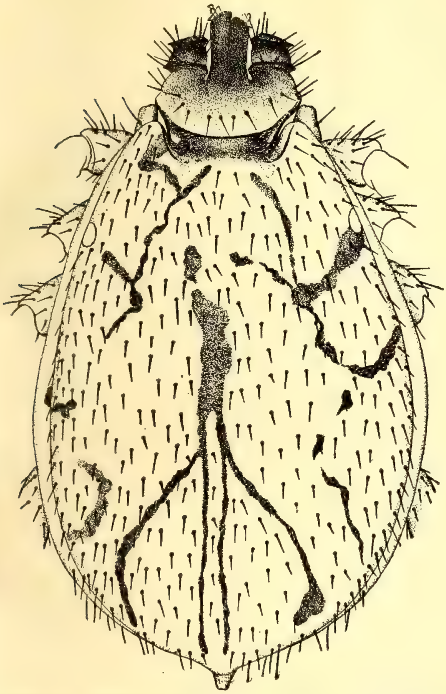

FIG. 140.—Dorsal view of male *Boophilus australis*, from Porto Rico, after several generations on cattle at Bethesda, Md. Greatly enlarged. Original.

Marx (1892) states that "*Rhipicephalus* is represented in North America by a beautiful species from California, and one from Cape Disappointment, Washington." After the elimination of the Texas fever tick, however, we are not personally acquainted with any North American species of *Rhipicephalus*. *R. sanguineus* is reported by Neumann for Panama, and *R. bursa americanus* for Jamaica. We have specimens of an undetermined *Rhipicephalus* from Porto Rico.

The following table of species is given by Neumann:

KEY TO THE SPECIES OF THE GENUS RHIPICEPHALUS.[1]

[For forms (*Boophilus*) reported in the United States, follow Roman type.]

Females	1
Males	13
Nymphs (*Phaulixodes*)	23

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[1] This key does not include the following species: *R. javanensis*, *R. flavus*, *R. bhamensis*, *R. hæmaphysaloides*, *R. ruber*, *R. Linnei*.

A.—Female.

1. *Palpi flat dorsally, sides straight or convex* 2
Palpi short, thick, angular, second and third articles each drawn out laterally to a sharp point (*Boophilus*) 12
2. *Scutum brown or brownish* 3
Scutum white (Zanzibar) .... *R. pulchellus.*
3. *Abdomen of uniform color* 4
Abdomen with white lines and points (Zanzibar) .... *R. perpulcher.*
4. *Scutum elongate oval* 5
Scutum short oval or as broad as long 8
5. *Scutum decidedly emarginate in front* 6
Scutum slightly emarginate in front (Zanzibar) .... *R. brevicollis.*
6. *Scutum with unequal (large and small) punctations* (Europe, Asia, Africa, Australia, Philippines, Central America) .... *R. sanguineus.*
Scutum with equal punctations 7
7. *Punctations linearly arranged, few in number* (Sumatra) .... *R. paulopunctatus.*
Punctations numerous (Africa) .... *R. punctatissimus.*
8. *Anal valve not bordered with white* 9
Anal valve bordered with white (Egypt) .... *D. rutilus.*
9. *Scutum with distinct punctations* 10
Scutum rough (shagreened) 11
10. *Punctations equal, close together* (Europe, Africa, West Indies) .... *R. bursa.*
Punctations unequal, separated (Africa) .... *R. simus.*
11. *Scutum not rough on margins; eyes light* (South Africa) .... *R. capensis.*
Scutum rough (shagreened) on entire surface; eyes dark (South Africa) .... *R. Evertsi.*
12. Scutum elongate, sides convergent back of the eyes (see p. 420) .... *R. annulatus.*
Scutum oval, sides not convergent back of the eyes (Africa) (see p. 433) .... *R. decoloratus.*

B.—Male.

13. *Palpi flat, sides straight or convex* 14
Palpi short, thick, angular; second and third joints each drawn out laterally into a sharp point (see *Boophilus*, p. 419) .... *R. annulatus.*
14. *Scutum of uniform color* 15
Scutum black and white (Zanzibar) .... *R. pulchellus.*
15. *Marginal groove of shield single* 16
Marginal groove of shield double (China) .... *R. carinatus.*
16. *Scutum with numerous punctations* 17
Scutum with few large punctations linearly arranged 22
17. *Punctations unequal (large and small)* 18
Punctations equal or nearly so 19
18. *Punctations distributed regularly* (Europe, Asia, Africa, Australia, Central America) .... *R. sanguineus.*
Punctations distributed irregularly (Africa) .... *R. punctatissimus.*
19. *Punctations separated (distant)* 20
Punctations contiguous, making scutum rough (shagreened) 21
20. *Punctations fine, covering entire surface* (Europe, Africa, West Indies) .... *R. bursa.*
Punctations deep, absent from margin and marginal shields (Nubia) .... *R. compositus.*
21. *Postero-marginal festoons with white border* (South Africa) .... *R. capensis.*
Postero-marginal festoons of uniform color, only slightly distinct (South Africa) .... *R. Evertsi.*
22. *Scutum (of young specimens) cover entire dorsal surface* (Africa) .... *R. simus.*
Scutum (of young specimens) absent from the margin (Sumatra) .... *R. paulopunctatus.*

C.—Phaulixodes.

23. *Scutum longer than broad, with nearly straight sides* (see *R. sanguineus*)..... *rufus.*
Scutum longer than broad, sides curved (Algeria).......................... *plumbeus.*
Scutum as broad as long, sides slightly curved (Sumatra)................ *intermedius.*

Genus Boophilus[1] Curtice, 1891.

Generic diagnosis.—*Rhipicephalinæ*: Eyes present, often indistinct; base of capitulum broader than long, wider than combined width of palpi and haustellum, hexagonal on dorsal surface, forming at each side a projecting angle. Palpi short, broad; second and third articles nearly equal, and widest about the middle, where they are drawn out laterally into a sharp angle. Posterior margin of coxæ I bidentate, though often indistinctly. Stigmal plate round to oval. Male with two pairs of anal clypei.

Type species.—*Boophilus annulatus* (Say).

It can not be definitely stated at present how many species of *Boophilus* should be recognized. For North America only one form is described, *B. annulatus*, commonly known as *B. bovis.* Another form, *B. australis*, is found in Australia, India, South America, Cuba, and Porto Rico. A third form, *B. decoloratus*, is described from South Africa. It has been definitely established by Smith, Kilbourne, Schroeder, and others that *B. annulatus* is the transmitter of Texas fever in North America. *B. australis* has been shown to transmit the same disease in Australia, and Schroeder has transmitted Texas fever by means of Porto Rican ticks, which we look upon as identical with *B. australis.* Fuller believes that *B. decoloratus* acts as the transmitter of the fever in South Africa.

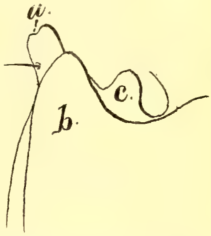

Fig. 141.—Antero-lateral corner, showing (*a*) projection of coxa I, (*b*) antero-dorso-lateral, and (*c*) antero-ventro-submedian projection of scutum.

Other species have been described for other countries, but it is practically impossible at present to give a reliable opinion as to whether these forms represent true species or geographical varieties or whether they are identical with the above-named species.

From a practical standpoint of quarantine, however, the difficulties are not so great as they are from a strictly zoological point of view; for since it has been established that the North American, Porto Rican, and Australian forms all transmit Texas fever, and since, further, this disease also occurs elsewhere, as in South America, South Africa, etc., it will be necessary to look upon any form corresponding to *Boophilus* as potentially infectious.

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[1] Synonymy and Bibliography.

1891: *Boophilus* Curtice, 1891a, pp. 313–319; type, *Ixodes bovis=annulatus.*—Idem, 1891b, p. 685.—Idem, 1892c, pp. 237–252, pls. i–ii.—Marx, 1892, pp. 235, 236.—Osborn, 1896, p. 257.—Morgan, 1899, pp. 138, 139.—Ward, 1900a, p. 202.—Stiles & Hassall, 1901, pp. 2–4.—Salmon & Stiles, 1901, pp. 419–446. [See also Neumann, 1897, p. 384, as syn. of *Rhipicephalus.*]

1898: "*Boophylis* Curtice" of Niles, 1898b, p. 25 (misprint for *Boophilus*).

The following key will serve to determine the various forms which come into consideration in connection with this genus:

KEY TO THE SPECIES OF THE GENUS BOOPHILUS.

[For forms reported in the United States, follow Roman type.]

1. *Fiery red spot anteriorly in middle field of female; male without a tail; number of rows of denticles unknown. Uncertain West Indian species* .... *Hæmaphysalis rosea*, p. 445
   No such spot reported for female; male with or without tail; 6 to 10 rows of denticles on hypostome 2
2. *Hypostome with 6 rows of denticles* 3
   Hypostome with 8 rows of denticles 4
   Hypostome with 10 rows of denticles; male with distinct horny tail. Type locality (Japan) .... *Rhipicephalus caudatus*, p. 437
3. *Male with distinct horny tail. The Blue Tick*, South Africa.... *B. decoloratus*, p. 433
   Male unknown. A doubtful South American form. Type locality, Buenos Aires, p. 445
4. *Male with distinct horny tail* (Australia, India, Venezuela, Cuba, and Porto Rico) .... *B. australis*, p. 427
   Male without horny tail 5
5. North American form (porose areas of female not united in median line) .... *Boophilus annulatus*, p. 420
   North African form .... *Ixodes Dugesii misdet.*, p. 439
   Caucasus form (*porose areas of female united in median line of capitulum*) .... *Rhipicephalus calcaratus*, p. 441

THE NORTH AMERICAN TEXAS FEVER TICK (*Boophilus annulatus*).[1]

(Figures 42–54, 59, 60, 62–64, 68, 151, 153a–b, 154a.)

SPECIFIC DIAGNOSIS.—*Boophilus: Male.*—Body oval, narrowed on front, broadest (1.3 mm.) at stigmal plane, 2.15 to 2.35 mm. long. Scutum reddish brown, covering entire dorsal surface, prolonged in front by two pairs of projections—one pair of more prominent dorso-lateral projections, dorsal of anterior projection of coxæ I, and one pair somewhat less prominent and more median, ventro-median of first pair and nearer the neck. Two cervical furrows shallow, extending more or less distinctly to the posterior border; may be somewhat interrupted in the middle; a median furrow present in posterior half, may be very indistinct; posterior margin of body divided into festoons which may be only slightly marked. Relatively large circular pores, with extruding short bristly hairs, scattered over entire surface. Eyes small and pale, often problematic, at I intercoxal space. Ventral surface lighter than dorsal, all portions provided with short stout hairs; genital pore, broad, transverse, between coxæ II; anus slightly posterior of stigmal plane; two pairs of anal plates (clypei): one pair elongate, rectangular to triangular, close to anus, in some cases extending cephalad to middle of coxæ IV, and caudad to near or beyond posterior margin, the anus being about at the middle of the length, in other cases extending from height of middle of stigmal area to beyond posterior margin of body; the median border longer than lateral border, the former prolonged into a point posteriorly, the postero-lateral margin may be nearly straight, or somewhat curved, or irregular in outline, thus presenting broad tooth-like projections; lateral and contiguous to each of these shields is found another shield somewhat similar in form but smaller in size. Median caudal appendage absent. Capitulum 450 to 500μ long, base similar to that of the female, but a little straighter, longer, more salient in front of dorsal shield, into which it penetrates by a sort of rectangular neck, lateral projections not very prominent. Mandibles 600μ long, digit about 90μ; internal apophysis with straight base and broad bifide point; external apophysis bidentate, the terminal subventral tooth may be very small while the proximal tooth is strong and large, or both may be large. Hypostome similar to that of female, four distinct rows of teeth on each half. Palpi about 190μ long, similar to those of female. Legs strong; coxæ large, those on each

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[1] SYNONYMY AND BIBLIOGRAPHY.

1821: *Ixodes annulatus* SAY, 1821, pp. 75, 76; type host, *Cervus virginianus*=*Cariacus americanus*, East Florida.—GERVAIS, 1847, p. 351. [Given as syn. of *Boophilus bovis* by CURTICE, 1891a, p. 318; 1891b, p. 685; DOLLY, 1894, p. 1000.—OSBORN, 1896, p. 257.] [See also NEUMANN, 1897, p. 407, as syn. of *Rhipicephalus annulatus.*—STILES & HASSALL, 1901, p. 3, as syn. of *Boophilus annulatus.*]

1869: *Ixodes bovis* RILEY, 1869, p. 168, and RILEY MS. in Packard, 1869, p. 68; type host, *Bos taurus;* Missouri.—VERRILL, 1870, p. 117, fig. 41.—PACKARD, 1873, pp. 740, 741.—LINTNER, 1874, p. 631.—MURRAY, 1877, pp. 182, 188, 193, 194.—COBBOLD, 1879, pp. 267, 350, 389.—JOHNSON, 1884, p. 78.—BEARDSLEE, 1884, pp. 84, 85.—COOK, 1888, p. 405.—NEUMANN, 1888, p. 95.—IDEM, 1892a, p. 100.—IDEM, 1892b, p. 103.—RILEY & HOWARD, 1889, p. 20.—THE LANCET, 1892, I, p. 756.—Vet. Journ., 1892, p. 337.—HOLLAND, 1898, p. 96.—HUNT, 1898, p. 211. [Given as synonym of *Boophilus bovis* by CURTICE, 1892, p.

243.—DINWIDDIE, 1892, p. 7.—OSBORN, 1896, p. 257.] [See also NEUMANN, 1896, p. 11.—IDEM, 1897, p. 408.—WARD, 1900b, p. 437, as syn. of *Rhipicephalus annulatus.*]

1869: *Ixodes indentatus* GAMGEE, 1869, p. 121, fig. 18=*Ixodes bovis* renamed.

1891: *Boophilus* (*Ixodes*) *bovis* (Riley) CURTICE, 1891, p. 313.—IDEM, 1891b, p. 680.—MORGAN, 1894, p. 1004.

1891: *Boophilus bovis* (Riley) CURTICE, 1891a, pp. 313–319.—IDEM, 1891b, pp. 680–686.—IDEM, 1892a, pp. 1–7.—IDEM, 1892b, pp. 226, 231, 232.—IDEM, 1892c, pp. 237–252, pls. I, II.—IDEM, 1896, pp. 649–655.—IDEM, 1897a, p. 24.—MARX, 1892, p. 236.—DINWIDDIE, 1892, pp. 7–14.—RILEY & HOWARD, 1893, p. 267.—FRANCIS, 1894, p. 451.—IDEM, 1895, pp. 210–213.—MILLER, 1895, p. 11.—FULLER, 1896, pp. 760–787, pls. I–V [in part only].—LUGGER, 1896, pp. 119, 120, fig. 57.—OSBORN, 1896, pp. 257–260, pls. IV–V.—CONNAWAY, 1897, pp. 85, 89, 97, figs. 1, 2, 5.—HUNT, 1897, pp. 231–233.—LEWIS, 1897, p. 8.—MAYO, 1897, pp. 125, 126, 127, 129, fig. 1.—DALRYMPLE, MORGAN, and DODSON, 1898, pp. 240–243, pls. II–VI.—FREER, 1898, pp. 256–260.—NILES, 1898a, pp. 27, 30, pl. II, figs. 1–6.—IDEM, 1898b, p. 45.—POUND, 1898, pp. 404–407.—BIRD, 1899, pp. 1, 5, figs. 1–6.—LEWIS, 1899, pp. 3–5, figs. 1–2.—MORGAN, 1899, pp. 128, 129, 130, 134, pls. I, II.—LÜHE, 1900, p. 443.—WARD, 1900a, pp. 195, 201, 202, figs. 5–6.—IDEM, 1900b, p. 437. [See also NEUMANN, 1897, p. 408, as syn. of *Rhipicephalus annulatus.*—STILES & HASSALL, 1901, pp. 2, 3, as syn. of *Boophilus annulatus.*]

1897: *Rhipicephalus annulatus* (Say) NEUMANN, 1897, pp. 384, 407–414, 419, figs. 37–40, in part.—FULLER, 1899, pp. 389, 391.—WARD, 1900a, pp. 201, 202.—IDEM, 1900b, p. 437. [See also STILES & HASSALL, 1901, p. 2, as syn. of *Boophilus annulatus.*]

1897: "*Ixodes identatus* Gamgee" of NEUMANN, 1897, p. 408 (misprint for *Ixodes indentatus*).

1898: "*Boophylis bovis*" (Riley) of NILES, 1898b, p. 25, for *Boophilus bovis.*

1901: *Boophilus annulatus* (Say) STILES & HASSALL, 1901, pp. 2, 3.—SALMON & STILES, 1901, pp. 420–426, figs. 42–54, 59, 60, 62–64, 68, 151, 153*a–b*, 154*a*.

side contiguous, as broad as long; coxæ I triangular, apex may be prolonged anteriorly beyond the corresponding anterior point of dorsal shield, reaching anterior angle of base of capitulum, or may be very short, base posterior and more or less distinctly bidentate, the teeth short, often slightly pronounced, or quite prominent, the lateral tooth in some cases prolonged into a well-marked spine. Tarsi like those of female.

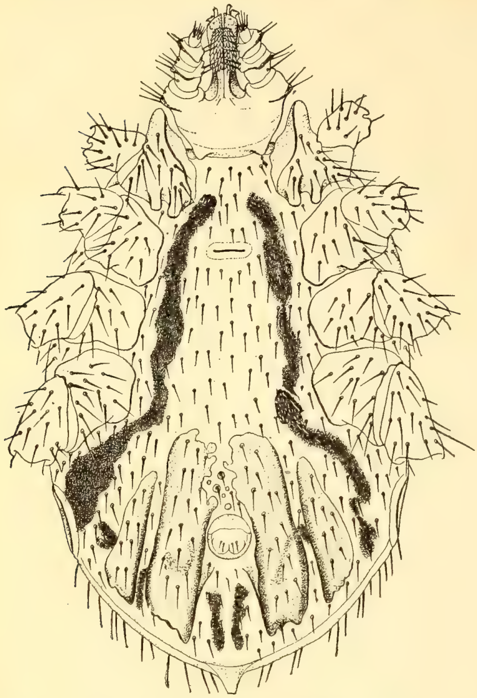

FIG. 142.—Ventral view of same specimen. In the living animal, a distinct peristalsis can be seen in the dark canals which shine through the integument. Original.

Female.—Body elliptical, as broad in front as in back, usually somewhat constricted in middle, near IV pair of legs; may attain 13 mm. long, 7.5 mm. broad. Color exceedingly variable; live specimens vary from a tawny yellow (younger forms) to an olive green (very old specimens), alcohol specimens from yellow to red or black; the excretory system often shows through the cuticle as tortuous whitish canals. Dorsal shield (scutum) very small, visible as a dark brownish spot in a depression at anterior end of median line; usually about 1.1 mm. long by 0.8 to 0.9 mm. broad, decidedly emarginate anteriorly to receive capitulum; lateral borders nearly straight and parallel in anterior portion, from antero-lateral points to eyes, then convergent from eyes caudad, forming a more or less bluntly rounded posterior angle in median line; cervical grooves divide the anterior half of scutum into three more or less equal longitudinal fields, and diverge posteriorly; surface of scutum provided with short bristles which are more numerous near anterior border and near the eyes than elsewhere. Eyes rather small near anterior third of margin of scutum. On nearly the entire length of dorsal surface of body are two antero-posterior grooves, interrupted or nearly effaced near plane of IV pair of legs, and ending a short distance from the shield and from posterior margins of body; also an unpaired median groove in posterior half of body; all three vary with the muscular contractions and may more or less completely disappear when body is replete. Ventral surface shows four pairs of more or less distinct marginal constrictions corresponding to the four pairs of legs, the IV constriction being most marked; antero-median region also depressed at insertion of capitulum; vulva small, median, at plane of coxæ I; sexual grooves corresponding to the paired dorsal grooves; but showing some variation in different specimens; median groove extending from anus to posterior margin. Anus about on border of second and last thirds of body. Stigmata short oval; stigmal pore slightly

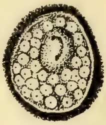

FIG. 143.—Stigmal plate of male. Greatly enlarged. Original.

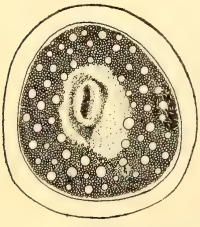

FIG. 144.—Stigmal plate of female. Greatly enlarged. Original.

crescentic, convexity lateral; stigmal field with numerous larger and smaller wart-like structures forming a zone near the margin. Cuticle of entire body finely wrinkled, bearing short hairs. Capitulum very short, about 800 μ from posterior dorsal margin to anterior end of hypostome; base of capitulum hexagonal, enlarged on its dorsal surface; inserted in emargination of scutum; lateral projections not very prominent. Mandibles 860 μ long, digit 120 μ. Internal apophysis conical (Neumann), bidentate (Fuller), with its base near the terminal extremity; external apophysis with three successive teeth, one terminal, subventral, small; the second stronger; third large. Hypostome rather spatulate, broad, a little longer than the palpi, provided on each half with four rows of nine to ten nearly regular denticles which do not extend to the

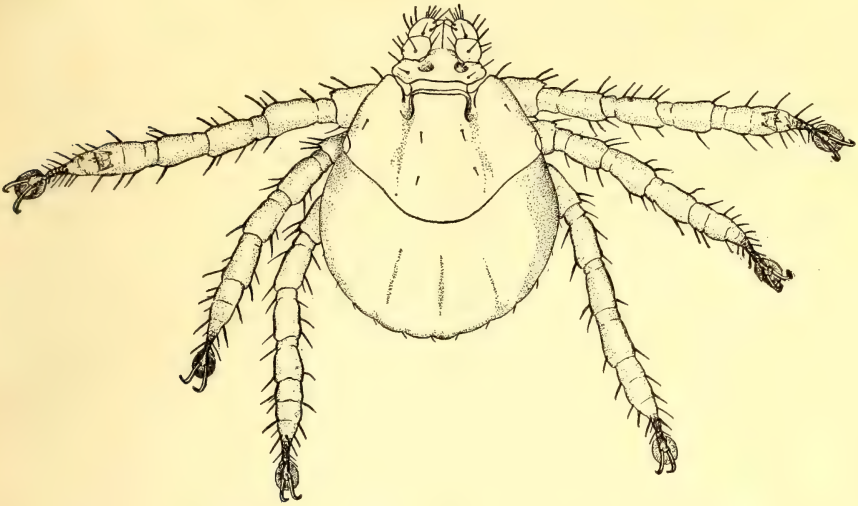

Fig. 145.—Dorsal view of hexapod larva of *Boophilus australis*,

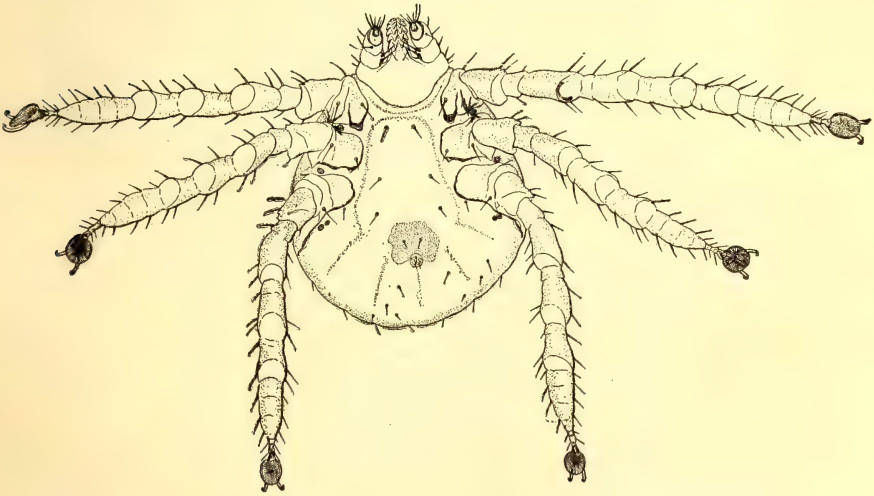

Fig. 146.—Ventral view of hexapod larva of same.

base. Palpi very short (310 μ), subconical, articles at least as broad as long; first article partially hidden under the antero-dorsal border of the base of the capitulum; second article pedunculate, dilated in a salient crest in its middle portion, thus forming a prominence inward (toward median line) and outward, and provided with strong hairs, especially on the inner prominence; third article smaller, subtriangular on its dorsal surface, where it forms a projection in and out; fourth article small, cylindrico-conical, inferoterminal. Legs rather thin, short (pair I, 2 mm.; pair II, 2.5 mm.), yellowish brown, first articles darker than the others. Coxæ: pair I subtriangular, posterior border bidentate or biundulate, the division in many cases indistinct. Tarsi I unicalcarate, II to IV bicalcarate. Pulvillum about half as long as claws. Stiff bristle-like hairs on all articles.

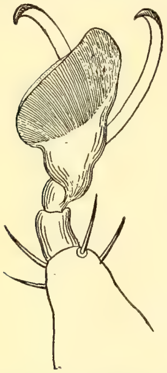

FIG. 147.—Dorsal view of claw I of hexapod larva of same. Original.

Hexapod larva.—Body oval, slightly narrowed in front, about 600 μ long and 470 μ broad, yellowish. Scutum thin, covering more than half the back, scarcely emarginate for capitulum. Short hairs on dorsal and ventral surfaces. Capitulum as broad as long; base a rectangle transversely elongate on dorsal surface, semicircular ventral surface. Mandibles 240 μ long, digit 32 μ, of same type as in male. Hypostome rather spatulate, provided on each half with two rows of five to seven teeth of nearly equal size. Palpi with nearly cylindrical articles, without lateral projections, provided with long hairs; fourth article relatively large, inserted on median surface of third. Legs relatively strong; coxæ somewhat similar to those of male; tarsi without spurs. Stigmata small, circular, between coxæ II and III, and posterior of coxæ III; possibly also between coxæ I and II.

Habitat.—On cattle and deer; southern portion of United States of North America; its southern limit is not established. Transcontinental quarantine line is based upon this species, which is the transmitter of Texas fever.

Historical review of Boophilus annulatus.

In 1821 Say described a North American tick as follows:

> Body oval, pale reddish brown, tinged with sanguineous, particularly behind, and with several longitudinal and oblique, black, abbreviated lines, scattered punctures, and three abbreviated, longitudinal impressed lines behind; *rostrum* [= capitulum], with the *palpi* dilated, rather suddenly contracted at base, and annulated more prominently beneath with about two elevated lines, which on the sides produce an angulated appearance, much shorter than the haustellum [= mandibles + hypostome], rounded at tip; *haustellum*, the two superior organs [= mandibles] emarginate at tip, exterior division dentate beneath, inferior organ [= hypostome] with numerous resupinate teeth [= denticles] resembling fenestrate punctures; posterior to the origin of the palpi above is an orbicular, obscure assemblage of punctures [= porose area] resembling eyes; black dorsal lines of the male somewhat regular, consisting usually of a dorsal line divaricating before, and behind, the middle, furnishing a branch each side, which at the tip of the abdomen is confluent with a lateral line, which also branches off in two or three short lines towards the feet; *feet* with a short, robust nail, and a reclivate pedunculated pulvillus and nails.
>
> Found in considerable numbers on a *Cervus Virginianus*, in east Florida.

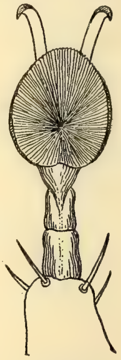

FIG. 148.—Ventral view of same. Original.

It will be noticed that Say's specimens were taken in Florida from the Virginia deer (*Cervus virginianus* = *Cariacus americanus*), hence this is the type host, while Florida is the type locality for the species *B. annulatus.* There is, however, scarcely room for serious doubt regarding its identity with a tick described in 1867 by C. V. Riley, late Entomologist of the U. S. Department of Agriculture, as a new species, *Ixodes bovis;* type host, neat cattle; type locality, Missouri. Riley's original diagnosis reads:

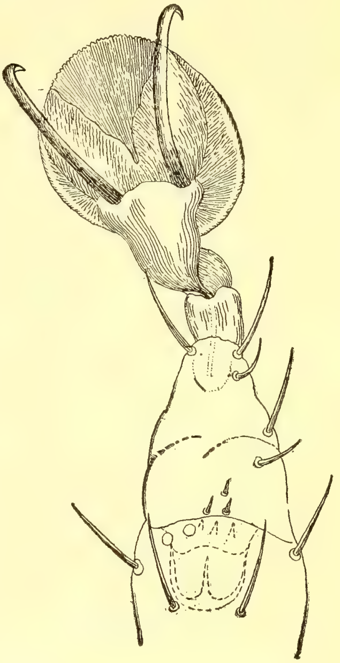

FIG. 149.—A view of claw II of *Boophilus australis*, same magnification as figs. 147 and 148.

> *Ixodes bovis* (Riley). A reddish, coriaceous, flattened species, with the body oblong-oval, contracted just behind the middle, and with two longitudinal impressions above the contraction and three below it, more especially visible in the dried specimen. Head short and broad, not spined behind, with two deep round pits. Palpi and beak together unusually short, the palpi being slender. Labium [= hypostome] short and broad, densely spined beneath. Mandibles smooth above, with terminal hooks. Thoracic shield distinct, one-third longer than wide, smooth and polished; convex, with the lyrate medial convexity very distinct Legs, long and slender, pale testaceous red; coxæ not spined. Length of body, 0.15 of an inch; width, 0.09 of an inch. Missouri Coll., C. V. Riley.

This is the cattle tick of the Western States. Several hundred specimens in different stages of growth have also been received from Pulvon, west coast of Nicaragua, taken from the horned cattle, and on a species of dasyprocta, by Mr. J. McNeil. They preserve the elongated flattened form, with the body contracted behind the middle, by which this species may be easily identified. The largest specimens measure 0.50 by 0.30 of an inch. When gorged with blood they are nearly as thick through as they are broad. In the freshly hatched hexapodous young, and the young in the next stage of growth, the thoracic shield is one-third the size of the whole body, which is pale yellowish, with very distinct crenulations on the hinder edge. The fourth pair of legs are added apparently at the first molt. It is called the "garapata" by the inhabitants of Nicaragua.

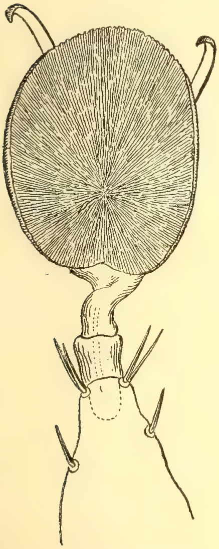

FIG. 150.—A view of claw II of same; magnification same as figs. 147 and 148.

In the same departmental publication in which Riley published his description of *I. bovis*, Gamgee proposed to call the same tick *Ixodes indentatus.* No question can arise, therefore, regarding the identity of *I. bovis* and *I. indentatus.* Packard (1873, p. 740) copied Riley's diagnosis, but gave a figure of the female of a *Dermacentor* instead of the true *I. bovis.* He states that Merriam collected *I. bovis* in 1870 from a porcupine (*Erithizon epixanthus*) in Idaho, and that it was also taken in Wyoming in 1873 from a rabbit (*Lepus Bairdii*). If the determination was correct, these must have been ticks carried north by Southern cattle, for *B. annulatus* does not normally occur so far north. Murray (1877, pp. 193, 194) says that a specimen was taken from a miner's neck in Utah, and he thinks that the tick on the moose referred to by Capt. Campbell Hardy (Forest Life in Acadie, 1869) is identical with this form. It seems more probable, however, that Hardy's form is *Dermacentor variegatus*, and there are some doubts in our minds regarding the correctness of the determination in the Utah case.

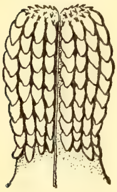

FIG. 151.—Diagram of the labium of *Boophilus annulatus* and *B. australis*. After Fuller, 1899, p. 391, fig. 11.

Curtice (1891) proposed *Ixodes bovis* as type of a new genus, *Boophilus*. It was also Curtice who suggested that this species was possibly identical with *Ixodes annulatus* and *Hæmaphysalis rosea*. Curtice's genus *Boophilus* has been generally accepted by American authors, but was rejected by Neumann (1897), who placed *B. bovis* in *Rhipicephalus* as *R. annulatus*. Neumann unites under this species the following forms: *Ixodes annulatus* Say, 1821; *Hæmaphysalis rosea* Koch, 1844; *Ixodes bovis* Riley, 1869; "*I. Dugesii*" of Mégnin, 1880; *Hæmaphysalis micropla* Canestrini, 1887; *Boophilus bovis* (Riley); *Rh. calcaratus* (Birula), 1895; *Rh. annulatus caudatus*.

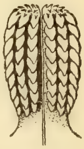

FIG. 152.—Diagram of the labium of *B. decoloratus* and *Rhipicephalus Evertsi*. After Fuller, 1899, p. 391, fig. 12.

Fuller (1899) compared the North American, the Australian, and the South African forms and considered that they represented distinct species (see below, p. 430). He follows Neumann by not adopting *Boophilus*.

THE AUSTRALIAN, SOUTH AMERICAN, CUBAN, AND PORTO RICAN TEXAS FEVER TICK (*Boophilus australis*).[1]

(Figures 114–151, 153*d*, 154*c*.)

SPECIFIC DIAGNOSIS.—*Boophilus: Male.*—Body oval, narrowed in front, broadest (about 1.3 mm.) in region of stigmata and coxæ IV, 2.2 to 2.3 mm. long. Scutum reddish brown, extends from anterior to posterior margin of body, but leaves a narrow lateral margin uncovered, prolonged in front by two pairs of projections; one pair of

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[1] SYNONYMY AND BIBLIOGRAPHY.

1887: ? *Rhipicephalus micropla* CANESTRINI (1887) (see below, p. 437).
1897: ? *Rhipicephalus annulatus caudatus* NEUMANN, 1897 (see below, p. 437).
1899: *Rhipicephalus australis* FULLER, 1899, pp. 389–394, figs. 3. (See also STILES & HASSALL, 1901, p. 2.)
1900: "*Boophilus bovis* (Riley)" of FULLER, 1896, pp. 760–787 [in part] and LIGNIÈRES 1900, pp. 88–96, pls. X–XI.
1901: *Boophilus australis* (Fuller) STILES & HASSALL, 1901, pp. 2, 3.—SALMON & STILES, 1901, pp. 426–433, figs. 114–151, 153*d*, 154*c*.

PLATE LXXX.

Fig. 114.—Dorsal view of male *Boophilus australis*, from Cuba. Natural size. Original.

Fig. 115.—Ventral view of same.

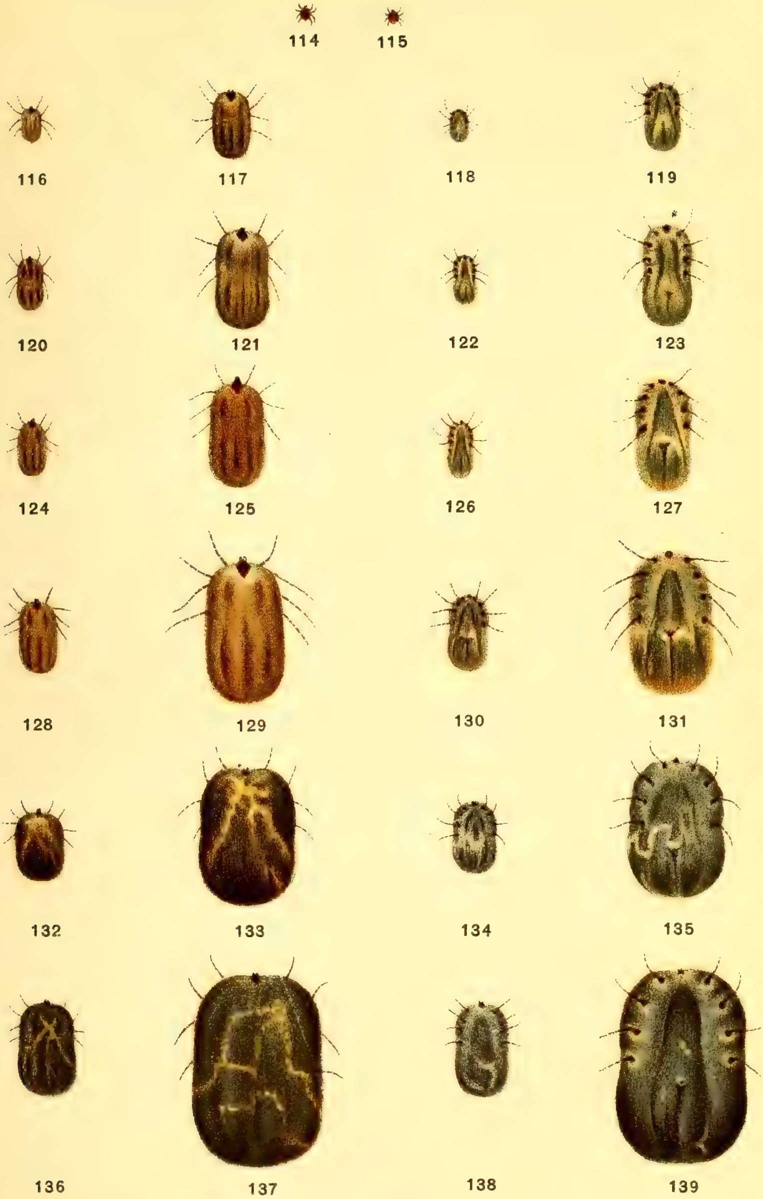
Figs. 116, 120, 124, 128, 132, 136.—Dorsal view of female *Boophilus australis*, from Cuba, showing variation in color and form. Natural size. Original.

Figs. 117, 121, 125, 129, 133, 137.—The same, twice natural size.

Figs. 118, 122, 126, 130, 134, 138.—The same, ventral view.

Figs. 119, 123, 127, 131, 135, 139.—The same, twice natural size.

PLATE LXXX.



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DORSAL AND VENTRAL VIEWS OF MALE AND FEMALE BOOPHILUS AUSTRALIS.

more prominent dorso-lateral pointed projections, dorsal of anterior projections of coxæ I, and one pair less prominent and more median, somewhat semilunar with concavity median, surrounding the base of the neck. Two shallow cervical furrows, extending more or less distinctly to posterior margin of body, may be interrupted in the middle; a median furrow present in posterior half, may be indistinct; festoons of posterior margin very indistinct. Distinct circular pores with extruding short, stout bristly hairs scattered over entire surface. Eyes small, pale, at I intercoxal space. Ventral surface lighter than dorsal, all portions provided with short, stout hairs. Genital pore broad, transverse, between coxæ II. Anus slightly posterior of stigmal plane; anal plates (clypei) more chitinous than those of *B. annulatus*. Strong chitinous cervical median caudal appendage present, 85 μ long. Capitulum about 425 μ long, postero-lateral spines of base more marked than in *B. annulatus;* mandibles about 600 μ, digit about 90 μ; internal apophysis apparently with three teeth; external apophysis bidentate (only 3 specimens examined). Hypostome with four rows of teeth on each half, the inner row may be less strongly developed than the others.

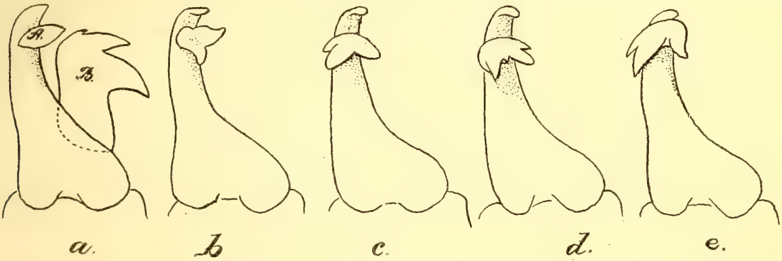

FIG. 153.—Diagrams of mandibles: *a, b, Boophilus annulatus; c, B. decoloratus; d, B. australis; e, Rhipicephalus Evertsi.* After Fuller, 1899, p. 391. *a* and *e* from Neumann.

Palpi about 200 μ long, in general similar to those of *annulatus*. Legs strong; coxæ similar to those of *annulatus*, but bidentation of I pair much more marked. Tarsi similar to *R. annulatus*.

Female.—Very similar to female of *B. annulatus*, but the lateral constriction at the stigmata is usually more marked. Body elliptical, as broad in front as in back; when replete, may attain 10 to 12 mm. long by 6 to 7 mm. broad. Color varies like *annulatus*. Dorsal shield smaller, somewhat lighter in color. Eyes small, near middle or anterior third of lateral margin of scutum. Capitulum very short, 560 to 612 μ from postero-dorsal margin to anterior end of hypostome, quite similar to that of *annulatus* except lateral projection slightly more marked. Mandibles 765 μ long, digit 120 μ; internal apophysis "tricuspid, and presenting a rounded process as well;" external apophysis tridentate as in *annulatus*. Hypostome spatulate, slightly longer than palpi, each half with four rows of 7 to 10 denticles which do not extend to the base. Palpi very short, about 320 μ long, articles at least as broad as long, in general similar to *annulatus*. Legs similar to *annulatus*.

Hexapod larva.—Similar to *R. annulatus;* in some cases a third pair of stigmata (between coxæ I and II) appears to be present.

Historical review of Boophilus australis.

The Australian and South American fever ticks were originally considered as identical with *B. annulatus*. When the Australian commission visited this Bureau, the writers of the present paper examined the Australian forms and expressed the opinion that they were certainly a distinct variety and in all probability a distinct species. The same specimens were examined by Ashmead, Schwarz, and Coquillette, who concurred in this view. This opinion was referred to by our Australian colleagues in one of their publications (Hunt and Collins, 1896, pp. 31, 32). Neumann, who examined the same specimens upon which we had based our view, looked upon the Australian form as identical with the North American. Fuller (1899, pp. 389–394), however, restudied the question and recognized the North American, the Australian, and the South African forms as three distinct species. The following extracts from his paper bear upon the question involved:

> Together with this I am sending you some notes on the various cattle ticks, from which you will see that I have found the North American, the Australian, and that from Cape Colony distinct from one another. The Queensland form appears to be a new species, for which I have proposed the name *australis;* it is curious that it is the same as the one Mr. Pound sent me as coming from South America.
>
> These notes I have written in a form suitable for reproduction in your Agricultural Journal, in the pages of which I should like to see them reproduced. Drawings suitable for making zinc blocks from are also sent, which, if added as illustrations, will render the notes much more valuable.

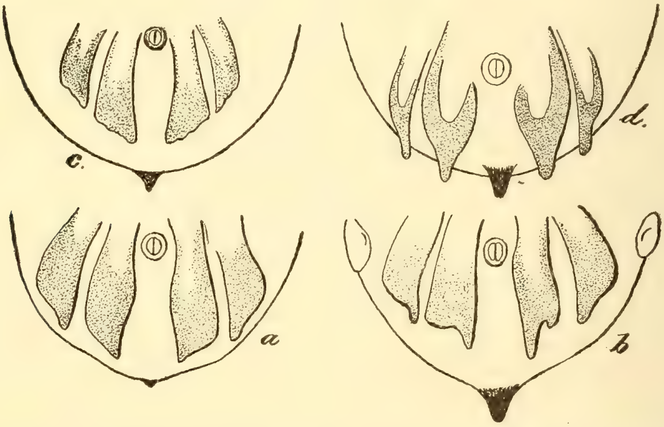

Fig. 154.—Diagrams of posterior margin of males: *a*, *Boophilus annulatus; b*, *Rhipicephalus caudatus; c*, *B. australis; d*, *B. decoloratus*. *a* and *b* from Neumann. After Fuller, 1899, p. 392.

> As early as 1893 the Queensland cattle tick was identified as *Ixodes bovis* Riley, by the late A. S. Olliff, and was until recently regarded as specifically identical with that species by many later students. I believe that the first doubt as to the correctness of this assumption was thrown out by Dr. D. E. Salmon, Chief of the U. S. A. Bureau of Animal Industry, in a letter to Mr. P. R. Gordon, chief inspector of stock (Queensland). In this communication (dated 9th December, 1897) Dr. Salmon says: 'You will possibly recall that we considered the Australian form distinct from our American form. Professor Neumann—who had for his monograph a very large 'number of specimens, including our entire collection, and has studied the Australian ticks which Dr. Hunt gave us some time ago—does not, however, agree with us on this point, but considers that they are identical."
>
> As it has since become important to settle the identity of the supposed redwater tick in Cape Colony, also said to be *I. bovis,* I have made a careful study of all three forms, and have come to the conclusion that they are three distinct species.

The specimens of *Rhipicephalus annulatus* Say (*Ixodes* (*Boophilus*) *bovis*) were kindly furnished through Mr. C. P. Lounsbury by Dr. L. O. Howard, entomologist, U. S. A., Dr. M. Francis, of Texas, and Prof. H. A. Morgan, of Baton Rouge, La. The Australian form and a few from South America, which prove to be identical with it were very kindly sent to me by my friends, Messrs. P. R. Gordon, chief inspector of stock, and C. J. Pound, director of the stock institute, Queensland.

The local Blue Tick, of which I have specimens from eastern and western parts of the colony, I regard as *Rhipicephalus decoloratus*, an insufficiently described species of Koch. Koch's description of this species is so meager that it is impossible to gather more from it than that he had a single specimen from the Cape of Good Hope, which was, judging from the color, an unimpregnated and undersized female. He figures the shield with two furrows, dividing it into three regions, the median yellow, the laterals red; and it is this feature, also noticed by Neumann, who had the opportunity of studying the original type, which has chiefly guided me in determining the species as *decoloratus*, there being no other species recorded from South Africa, or known to me, which possesses the same coloration of the dorsal shield.

The Australian species, also sent as from South America, is quite distinct from either the North American or the South African, and is therefore looked upon as a new species, for which the name *australis*, by which it is subsequently referred to, is proposed.[1]

The genus *Rhipicephalus*, to which the above species belong, has been reviewed by Professor Neumann, in an excellent treatise entitled a "Revision de la Famille des Ixodes,"[2] a work that has been of the greatest assistance in making these comparisons, so that it is with great regret that I find that I am at variance on one or two points with this most learned savant.

The genus, as may be gathered from the revision just quoted, contains some sixteen recognizable species which may be readily divided into two well-defined groups by referring to the number of furrows in the dorsal shield of the adult female; there being two in some species and four in others. The ticks under discussion belong to the former group, which appears to contain six species, namely, *annulatus* and Neumann's variety, *caudatus* (which I am prepared to regard as a distinct species), *Evertsi*, *pulchellus*, *decoloratus*, and the Australian-South American form, *australis*. Of these only *annulatus*, *decoloratus*, and *australis* have been studied directly, the characters of the rest being those given by Neumann, which are excellent descriptions, my North American specimens fully according with that of *annulatus*, except as regards the smaller process of the mandibles. This minute but important feature Neumann describes as being in the form of a simple cone; with this I do not agree, as, in the specimens I have examined, it is distinctly bicuspid, the additional tooth being often difficult to detect, as it is implanted at right angles to the more prominent one. The species is also credited with a very large geographical distribution, which includes parts of America and the West Indies, Australia, Asia, Sumatra, and Africa. I, however, have failed to find it among such ticks as I have from South America, Australia, and Cape Colony.

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[1] Mr. H. Tryon, entomologist to the Queensland department of agriculture, had already in an official report on the subject of the identity of this tick, on 1st February, 1899, pronounced on the distinctness of the Queensland cattle tick from *Ixodes bovis*. This officer, in the report alluded to, stated as follows: "These ticks are undoubtedly examples of *Ixodes bovis*, or rather of the Queensland variety of it, regarding which it may be stated that this differs slightly, as would appear from the typical form."—Ed. Q. A. J.

[2] Memoires de la Société Zoologique de France, Vol. IX, page 1, 1896, and Vol. X, page 324, 1897.

The chief characters which I have found of use in distinguishing the various species studied are: (1) The furrows of the dorsal shield of the female; (2) the number of rows of teeth to the labium or hypostome; (3) the form of the mandibles, particularly the lesser process (the internal apophysis of Neumann); (4) the extent of the dorsal shield of the male; and (5) the presence or absence of a "tail" to the male.

The following tables indicate the bearing of these features upon the species:

1. A. Furrows of the dorsal shield of the female extending to the posterior lateral margins: *R. annulatus, caudatus, Evertsi, decoloratus*, and *australis.*
   B. Furrows becoming obsolete in the middle of the shield at about half its length: *R. pulchellus.*

(This feature removes *pulchellus* from all others.)

2. A. Labium, or hypostome, with ten rows of teeth: *R. caudatus* (Neumn.).
   B. Labium, or hypostome, with eight rows of teeth: *R. annulatus* and *australis.*
   C. Labium, or hypostome, with six rows of teeth: *R. Evertsi* and *decoloratus.*

(This feature separates *caudatus* from the four remaining species and helps to separate *annulatus* and *australis* from *Evertsi* and *decoloratus.*)

3. A. Mandibles with lesser process, bicuspid: *R. annulatus.*
   B. Mandibles with lesser process, tricuspid (Neumn.): *R. Evertsi.*
   C. Mandibles with lesser process, bicuspid, and presenting a rounded projection as well: *R. decoloratus.*
   D. Mandibles with the lesser process, tricuspid, and presenting a rounded projection as well: *R. australis.*

(This feature differs in each species; there is a slight similarity between *annulatus* and *decoloratus* and *Evertsi* and *australis.*)

4. A. Male with the shield extending to the posterior margin: *R. annulatus, caudatus, decoloratus, australis.*
   B. Male with the shield not extending to the posterior margin (Neumn.): *R. evertsi.*

(This appears to be a ready feature for distinguishing *Evertsi* from *decoloratus.*)

5. A. Male with a distinct horny "tail:" *R. caudatus, decoloratus*, and *australis.*
   B. Male with small caudal protuberance: *R. Evertsi.*
   C. Male with no indication of a "tail:" *R. annulatus.*

(The absence of a tail to the male of *annulatus* readily separates it from the other species.)

From the differences in the various characters, brought out in the above tables, I have felt myself justified in reestablishing Koch's *R. decoloratus*, and in regarding the Australian tick as a new species. The following brief descriptions will, I think, suffice for the recognition of *australis* and *decoloratus:*

Rhi[pi]cephalus decoloratus Koch ("Uebersicht des Arachnidensystems," page 134.)

Female.—When replete, 10–12 mm. in length, and 6–8 mm. in breadth. Color uniform, slate blue. Shield of the same form as that of *annulatus* and *australis*, but smaller; furrows at first converging, then diverging to the posterior lateral margins; median region of a light yellow color, laterals red. Eyes not distinct. Labium with six rows of teeth. Mandibles with lesser process bicuspid, and presenting a rounded process as well. Legs generally yellowish, often red.

Male, adult.—Pale brown, and almost transparent, sometimes dark brown. Length, 2–3 mm. Labium with six rows of teeth. Adanal shields four, of the usual form, but more chitinous than those of *annulatus*, and prolonged into strong conical points. Abdomen ending in a strong chitinous caudal appendage.

Habitat.—On horses, cattle, etc.; Cape of Good Hope.

Rhipicephalus australis, n. sp.

Female.—When replete, measuring 10–11 mm. in length and 6–7 mm. in breadth. Dorsal shield smaller than that of *annulatus* and greater than that of *decoloratus*, of the same form and with similar furrows. Eyes, pale. Labium with eight rows of teeth. Mandibles with the lesser process tricuspid, and presenting a rounded process as well.

Male, adult.—Approaching that of *annulatus*, but with adanal shields more chitinous, and also exhibiting a caudal appendage. Neither the shields nor the "tail" are so pronounced as those of *decoloratus.*

Habitat.—On horses, cattle, etc.; northwest to northeast Australia.

For some time now there appears to have been doubt as to the identity of the Redwater ticks of Australia and North America with one another, and also with the supposed carrier of Redwater in Cape Colony—the Common Blue, or Blood, Tick. With the object of settling this point, at any rate so far as the common species in Cape Colony is concerned, a careful study has been made of these three forms, and the following notes are the results of these comparisons:

The fact that Redwater is carried from beast to beast by the agency of ticks was discovered but a few years ago by official investigators in the United States of America, where the disease has been the direct cause of great losses from time to time. These investigators found that one kind of tick, *Rhipicephalus annulatus* (Say) or, as it is more commonly known, *Ixodes bovis*, was the agent which disseminated the disease, and proved that not only did the bites of the ticks produce the disease, but, further, that the disease, or power of producing it, was communicated from the maternal tick through its eggs to the young. Subsequently, when this Redwater broke out in Queensland, Australia, it was found associated with a tick which many of us regarded as identical with the American one, and as this tick spread from district tc district, so the disease spread with it. In Cape Colony, Redwater has been gradually extending its range from the north along the eastern seaboard, and the common Blue, or Blood, Tick is no doubt the chief distributing agent. This species is referred to as the supposed or chief distributing agent of the disease, because of the great possibility that it is not the only agent, nor the only tick, for there is a probability that some, if not all, of our other common species, such as the larger Blue, the Red,[1] and the two Bontes,[1] may also act as transmitters; a probability enhanced by the fact that these investigations have shown that the Australian, the North American, and the local Common Blue, though closely allied and of the same genus, are distinct species. But as, up to the present, there does not appear to be any conclusive technical evidence upon this important point, I venture to draw attention to it as being a question invested with so much interest and practical importance that it is well worthy of attention, particularly in Cape Colony, where the opportunities of investigating it are so great.

Another interesting feature is that whilst in Australia and, I believe, the United States too, the ticks were strangers to those parts to which they carried the disease, such is not the case in Cape Colony. Our Blue Tick (*Rhipicephalus decoloratus* Koch) occurs in many parts of the colony, and is found where, I am given to understand, Redwater has never been known and where cattle could not have become immune. That the ticks are actually dissociated from the disease in these parts is proved by the fact that imported cattle do not contract Redwater when brought into contact with the native cattle. In Australia and North America the ticks have never, to my knowledge, been reported as so dissociated from the disease, and fever-stricken cattle were always infested with a particular tick, and unless a beast was actually immune by birth or had become so by previous infection or inoculation, the bites of these ticks were followed by the fever. There are, however, in both countries, particularly in the more southern and warmer parts of the United States, parts where tick-infested cattle exist in great numbers and do not suffer from acute Redwater. These cattle are, however, natives, and inherit their immunity from the disease while still carrying in their blood its "germs." From them the ticks are known to take the disease to susceptible cattle, either when mixing with these other cattle or grazing over the same ground within a certain period after they have crossed it. These susceptible animals have the disease carried to them by the young, or larval, ticks hatching from the eggs laid by those dropping from the former cattle. Ground traveled over by the cattle which carry the disease in their blood remains infected with the disease only so long as it is infested with these larvæ, and this period is limited by the length of time that they can live without food. This again, providing there is no reinfestation, is more or less extended according to climatic conditions—heat and cold, dryness and dampness, young ticks being very subject to such variations and capable of living a great while when they are favorable. Ground is said to remain infested for as many as six months in winter and two in summer in the case of the American Redwater tick, of which it is recorded that—[1]

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[1] Red tick=*Rhipicephalus Evertsi.* The Bonte tick=*Amblyomma hebræum.* The Bonte leg tick=*Hyalomma ægyptium.*

(1) The delay in the beginning of egg laying is nearly three weeks in winter as compared to twenty-four to forty-eight hours in summer.[2]

(2) The time elapsing between the laying of the first and the last egg by a female is, in summer temperature, only a few days, while in winter it may extend over a period of five weeks.

(3) In winter incubation is almost suspended, and months may elapse before hatching takes place. In summer the normal incubation period is about twenty days.

(4) Seed ticks (larvæ) are capable of existing without food four and one-half months in winter; in summer the time survived was about two months.

The short summer period does not, I am told by Mr. Hutcheon, C. V. S., actually apply to our local conditions, as there are certain evidences of veldt remaining infected for far greater periods.

We have recently received some ticks from Porto Rico, which resemble the Australian form in all essential details, except that the teeth on the internal apophysis—which both Neumann and Fuller discuss and figure as if they were easily studied—have baffled us. These characters may be of value in classification, as claimed by Fuller. On the other hand, we have not found them to be practical working characters; and, as the teeth on the external apophysis of *Boophilus annulatus* are subject to considerable variation, we are somewhat suspicious regarding those on the internal apophysis.

The Porto Rican ticks in question when first sent to Washington were much smaller than the North American form, resembling more closely the Australian specimens. After several generations, however, they became more elongate and resembled the North American form so closely that the females can not possibly be distinguished with the naked eye, and a microscopic determination is very uncertain. The

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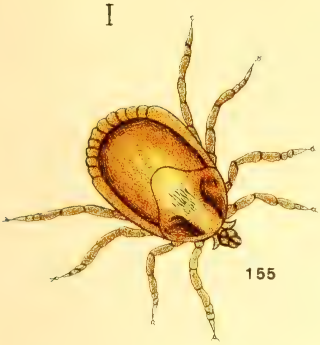
[1] "The following information is quoted from Bulletin 51 (2d Ser.) of the Louisiana State University and A. & M. College. The Cattle Tick and Texas Fever, by W. H. Dalrymple, H. A. Morgan, and W. R. Dodson. Baton Rouge, 1898."

[2] "In the case of the Bonte Poorten Tick (*Amblyomma hebræum* Koch) we find that there was a delay of from two to three months in beginning egg-laying in winter (May to July), and about a week in summer (January)."



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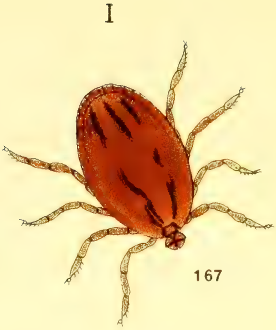

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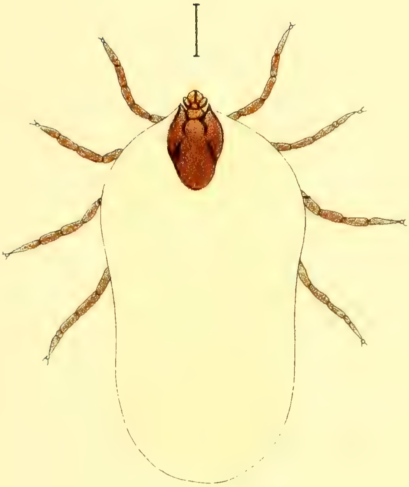

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Fig. 155. Original figure of Boophilus decoloratus. After Koch, 1847, pl. 30, fig. 110.

Fig. 167. Original figure of male Rhipicephalus rosea. After Koch, 1847, pl. 26, fig. 95.

Fig. 168. Original figure of female Rhipicephalus rosea. After Koch, 1847, pl. 26, fig. 96.

males, however, have remained perfectly distinct. Some specimens of ticks in our collection (B. A. I. Coll. 2997) taken at Boston from Venezuelan cattle, also B. A. I. Coll. 2977–2979, from Mandalay, Prone, and Shongwa Districts, India, agree with the Porto Rican forms in the two most important characters—eight rows of teeth on hypostome and presence of a tail in male—while no differences in other characters have been noticed.

At the Bureau Experiment Station, Dr. Schroeder has transmitted Texas fever by means of the Porto Rican tick.

Lignières (1900), in connection with his discussion of bovine malaria (Texas fever) in Argentina, mentions (p. 92) and figures (pl. XI, fig. 1) on the posterior extremity of the male a prolongation which he interprets as a penis. This is quite evidently the same as the caudal appendage of *B. australis.* Lignières erroneously supposes the Argentine form to be identical with our North American species. Apparently, Lignières found two rows of teeth on each half of the hypostome of the hexapod larva, three rows on each half in the nymph, and four rows in the adult female and male. Thus the presence of the tail in the male and eight rows of denticles in adult males and females would seem to indicate that the Argentine tick is identical with the Australian, Porto Rican, Cuban, and Venezuelan.

Canestrini's description of *Rhipicephalus micropla* is not accessible to us, but from the fact that Neumann (1897) has considered it identical with his *caudatus*, while Birula says that it is very closely related to his *calcaratus*, the possibility does not appear to be excluded that *australis* and *micropla* are specifically identical. This view gains in probability when we recall that *micropla* comes from Paraguay.

THE BLUE TICK OF SOUTH AFRICA (*Boophilus decoloratus*).[1]

(Figures 152, 153*c*, 154*d*, 155.)

SPECIFIC DIAGNOSIS.—*Boophilus: Male.*—Pale brown and almost transparent, sometimes dark brown. Length, 2 to 3 mm. Labium with six rows of teeth. Anal shields, four, of the usual form, but more chitinous than those of *annulatus*, and prolonged into strong conical points. Abdomen ending in a strong chitinous caudal appendage.

Female.—Body (when young) oval, sides slightly convex, posterior portion scarcely broader than anterior in specimens 2.2 mm. long by 1.3 mm. broad; when replete may attain 10 to 12 mm. in length, 6 to 8 mm. in breadth; color, uniform slate blue. Scutum of young longer than broad, rounded sides, punctations very superficial and very fine, brilliant, yellow in median portion, red on the sides, lateral of the anterior grooves; eyes red. Scutum of adults of same form as that of *B. annulatus* and *B. australis*, but smaller; furrows at first converging, then diverging to the posterior lateral margins; median region of a light yellow color, laterals red. Eyes not distinct. Dorsal surface of young yellowish white, smooth, the black intestinal ramifications showing through; lateral margin raised, without marginal groove, posterior festoons slightly apparent. Ventral surface yellowish, with underlying black spots; anus reddish. Capitulum red, base very short and broad; posterior angles scarcely salient, anterior and posterior, also antero-lateral and postero-lateral borders equal. "Mandibles with lesser [internal] process bicuspid, and presenting a rounded process as well." Hypostome with six rows of teeth (three on each lateral half). Legs generally yellowish, often red; coxæ contiguous; coxæ I with two short teeth; tarsi short with two consecutive spurs; pulvillum short, scarcely one-third as long as the claws.

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[1] SYNONYMY AND BIBLIOGRAPHY.

1844: *Rhipicephalus decoloratus* KOCH, 1844, p. 239.—IDEM, 1847, pp. 134, 135, Tav. XXI, fig. 110.—NEUMANN, 1897, pp. 414, 419.—FULLER, 1899, pp. 389–394, figs. 3.—LOUNSBURY, 1900, pp. 29–32, pl. III, fig. 1.

1899: "*Rhicephalus decoloratus* Koch" of FULLER, 1899, p. 392 (misprint for *Rhipicephalus decoloratus*).

1901: *Boophilus decoloratus* (Koch) STILES & HASSALL, 1901, pp. 2, 3.—SALMON & STILES, 1901, pp. 433–437, figs. 152, 153*c*, 154*d*, 155.

Habitat.—Cattle, horses, etc., Cape of Good Hope, Africa.

Historical review of Boophilus decoloratus.

This species was originally described by Koch (1844, p. 239) as follows:

Female.—Flat, oval, shining, ocher yellow, margin lighter all around; legs light yellow; length 1 line.

Male.—Unknown.

Habitat.—South Africa.[1]

In 1847 Koch repeated this diagnosis, to which he added the following description:

The outline more oval than egg-shaped, the border slightly raised, without distinct marginal groove on the hinder part; scutum shiny, with a groove on the sides, which unites with the curved grooves in front and back, and, as in several species, incloses a *rautenförmige* [= square, diamond-shaped, lozenge-shaped!] elevation. Capitulum short, broad, posterior margin straight anteriorly with a small groove each side of the insertion of the haustellum. Palpi small; legs as usual.

The entire body yellow dorsally, the *rautenförmige* elevation on the scutum with rust-reddish lines, capitulum and palpi darker yellow, both with brownish edges. Ventral surface and legs light yellow.

One specimen.[2]

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[1] *R. decoloratus.* Flach, oval, glänzend, ockergelb, der Rand rundum heller. Beine hellgelb. Länge 1‴. Weibchen.

Männchen: unbekannt.

Vaterland: Südafrika.

[2] *Rhipicephalus decoloratus.* Flach, oval, glänzend, ockergelb, der Rand heller, Beine hellgelb. Weibchen.

Männchen: unbekannt.

Länge 1‴.

Koch. Arch. f. Naturgesch. X. I., p. 239, n. 7.

Der Umriss mehr oval als eiförmig, der Rand ein wenig aufwärts erhöht, ohne deutliche Randfurche des Hinterleibes; der Kopfschild glänzend und auf diesem eine Furche über den Seiten, welche sich vorn und hinten mit den geschwungenen Furchen verbindet und wie bei mehreren Arten eine glänzende rautenförmige Beule einschliesst. Der Mundschild kurz, breit, hinten geradrandig, vorn beiderseits der Einfügung des Rüssels mit einem Grübchen. Die Taster klein; die Beine wie gewöhnlich.

Der ganze Körper oben gelb, die rautenförmigen Beulen auf dem Kopfschilde mit

This specimen, which is now in the Berlin Museum, was recently restudied by Neumann, who described it as follows:

Female.—Body flat, oval, a little convex at the sides, scarcely broader posteriorly than anteriorly; length, 2.2 mm.; breadth, 1.3 mm. Scutum longer than broad, rounded at the sides, with very superficial and very fine punctations, brilliant, yellow in its median portion, red on the sides, lateral of the anterior grooves; eyes red. Dorsal surface of the abdomen yellowish white, glabrous, redder in the middle, and, through its transparency, allowing the blackish ramifications of the intestines to be seen; lateral margin elevated, without marginal groove; posterior festoons slightly apparent. Ventral surface yellowish, with blackish spots [showing through] because of its transparency; anus reddish. Capitulum red, with a very short, broad base, the posterior angles barely projecting, the anterior and posterior margins equal, as also are the antero-lateral and postero-lateral margins. Palpi short, the second and third articles angular laterally. Legs rather short, yellowish white; coxæ contiguous; coxæ I with two short teeth, the others like the type; tarsi short, with two consecutive spurs; pulvillum short, barely attaining a third of the length of the claws.

Habitat.—South Africa.

This species is more closely related to *Rh. annulatus* than to any other, but insufficiently determined.[1]

Fuller (1899) has recently determined the Blue Tick of South Africa as identical with Koch's *Rh. decoloratus* (see above, p. 430); while Lounsbury (1900, pp. 29–32) accepts this determination as correct and gives the following account of its life habits:

The Blue Tick (*Rhipicephalus decoloratus* Koch).—This is the most abundant and the most widely distributed tick in the Colony. It takes its popular name from the color of the distended female, which is a displeasing bluish gray. The small size of this species, its almost colorless, slender legs, the color of the female, and a small but distinct tail-like projection from the body of the male are characters which serve for its ready separation from our other common ticks. The distended female measures

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rosträthlichem Anstriche, Mundschild und Taster dunkler gelb, beide mit bräunlichen Kanten. Die Unterseite und die Beine hellgelb.

Ein Exemplar.

Vaterland: Südafrika.

[1] *Femelle.*—Corps plat, ovale, à côtés peu convexes, à peine plus large en arrière qu'en avant, long de 2mm2, large de 1mm3. *Ecusson* plus long que large, à côtés arrondis, à ponctuations très superficielles et très fines, brillant, jaune dans sa partie médiane, roux sur les côtés, en dehors des sillons antérieurs; yeux roux. *Face dorsale* de l'abdomen blanc jaunâtre, glabre, plus rousse dans le milieu, laissant apercevoir par transparence les ramifications noirâtres de l'intestin; bord latéral relevé, sans sillon marginal; festons postérieurs peu apparents. *Face ventrale* jaunâtre, à taches noirâtres par transparence; anus roussâtre. *Rostre* roux, à base très courte et large; les angles postérieurs à peine saillants, les bords antérieur et postérieur égaux entre eux, ainsi que les bords latéraux antérieurs et postérieurs. Palpes courts, le 2e et le 3e articles anguleux en dehors. Pattes plutôt courtes, blanc jaunâtre; hanches contiguës; celles de la 1re paire à deux dents courtes, les autres semblables au type; tarses courts, avec deux éperons consécutifs, caroncule courte, atteignant à peine le tiers de la longueur des ongles.—*Patrie*: Afrique méridionale.

D'après l'exemplaire de Koch, Afrique australe (Muséum de Berlin).

Espèce plus voisine de *Rh. annulatus* que de toute autre; mais insuffisamment déterminée.

about one-half inch in length by about one-third as wide. The male is brownish yellow, with dark markings; is only about an eighth of an inch in length, and, in common with the early stages of both sexes, escapes general notice. It is generally to be found beneath the distended female.

The Blue Tick is nearly related to the common cattle ticks found in Australia, North and South America, and in other parts of the world. Prof. G. Neumann, an eminent authority on ticks, considers that it should be connected with the American cattle tick (*Rhipicephalus annulatus* Say; *Boophilus bovis* Riley) as a variety, and he will probably classify it as such in a new work which he has in preparation.

Notes on the life cycle of the species were given in the Agricultural Journal for November 24, 1898, by Veterinary Surgeons Dixon and Spreull. I have reared several different lots on cattle and goats, but have not yet traced all the habits. The eggs to the number of several thousands are laid on or near the surface in grass stubble or similar shelter and the larvæ on hatching ascend the grass or bush, as in the other species studied. Two thousand two hundred and fifty larvæ have been counted at the top of a single blade of grass. By day and by night, through wind, rain, and light frost, they remain at their posts. Grass found infested and protected by a barrier of cut thorns was found to be still infested three months later, which shows that the young ticks may live at least this length of time on the veld. The female, after dropping from the host, starts laying in from five days to two weeks in summer, while in winter at Cape Town, at a temperature of 65° to 70°, she delays until the third or fourth week has passed. Similarly, the incubation period of the egg varies from three weeks to three months. At a temperature of 85° to 90° in the incubator hatched eggs have been obtained in four weeks from the dropping of the mother tick, which shows how heat hastens the development. Some moisture appears necessary during the incubation period, as several batches of eggs kept in dry boxes have shriveled and failed to hatch.

The Blue Tick molts twice, but remains on its host through both changes, thus differing materially in habit from the Bont, Bont Leg, Red, and other South African species; it, however, becomes motionless, and appears as if devoid of life before both molts. The larva begins to distend by the end of the second day of its attachment, and seems to cease enlarging in from three to three and one-half days. Two days later, under a magnifying glass, the body contents may be seen to have shrunk away from the skin back to the mouth organs. Finally this larval skin ruptures across the top in front, and the tick, now in the second, or nymph, stage, crawls out. This change has been observed to take place as early as six days from the attachment of the larva, and as late as the tenth. The nymph settles down near by and after a few days distends, just as did the larva. In appearance, it resembles the adult female, but its sides, in place of being parallel, converge slightly towards the rear. After the fifth day from the molt, no further enlargement is perceptible, and doubtless feeding has ceased. In another day or two the outlines of the adult are dimly distinguishable through the translucent skin, particularly across the front, and shortly thereafter there is a rupture as before, and the tick makes its appearance as the adult. The nymphic stage has about the same duration as the larval; in instances observed it has varied from seven to ten days. The two stages together in numerous cases occupied from fifteen to twenty days. The male is very similar to the female in size, color, and general appearance just after the molt, and, being small, one might be easily mistaken for the other when viewed by the unaided eye. The female settles down almost at once, and so, apparently, does the male; but the latter wanders much farther and is therefore not easily traced. After a day or two males are seen crawling about in the hair, evidently searching for mates. I am not certain how soon mating takes place after moulting, but my observations lead me to conjecture that both sexes feed for a short time, and that the male then lets go his hold and looks for a companion. However that may be, the females nearly all have mates by the fourth day.

Distention has begun by that time, and seems to proceed whether or not a male has come up; this is another point that needs confirmative observation. A few females observed have fallen in seven days, but the great majority have not fallen until after the ninth day, and some have remained until the eleventh. The male remains on the skin when his mate drops, but what becomes of him afterwards I have not observed.

The life period on the host for the female is thus from three to four and one-half weeks. No individual ticks that I have observed have, however, dropped in less than twenty-three days, and most remained for twenty-six. The entire life cycle may be passed in two summer months, but, in fact, probably seldom takes less than two and a half or three. There is a possibility of three broods a year in our Cape climate and a probability of at least two broods.

The life period on the animal during the winter months is not likely to be more than a day or two longer than in the summer, at least when dry weather is the rule in winter as it is in our eastern sections. Being hidden in the hair when young and pressed against the warm body of the animal, the tick is kept warm throughout its stay. Numerous nymphs and some larvæ, which I scraped off after they had ceased to feed, moulted when kept in glass tubes; but the change in some cases took over a week in place of the two or three days as it would have on the warm skin. Some of the adults obtained in this way were kept alive for twelve days in the tubes and were then placed in spirit; as they can thus do without food, it can not be necessary for them to settle down at once after molting on an animal.

BOOPHILUS OF DOUBTFUL SYSTEMATIC POSITION.

Besides the above-described forms, other ticks have been described which belong to *Boophilus*, but their exact status must be determined by a comparison of the specimens in question with the other forms. They will be mentioned here under the generic name (*Rhipicephalus*) under which they were described, rather than as *Boophilus*, in order to avoid unnecessarily increasing synonyms.

A.—HYPOSTOME WITH TEN ROWS OF DENTICLES. MALE WITH TAIL.

Rhipicephalus caudatus[1] (Neumann, 1897) Fuller, 1899.

(Figure 154*b*.)

Neumann proposed for certain ticks a new variety, under *Rhipicephalus annulatus*, naming it *Rh. annulatus caudatus*. It is apparent that the Japanese specimens were looked upon as types. He considered these identical with *Rh. microplus* Canestrini from Paraguay—under which circumstance the new name *caudatus* was not justified. Neumann's description reads:

I include also in *Rhipicephalus annulatus*, with the rank of a variety (*Rh. annulatus caudatus*), a form which is represented in my collection by 23 females and 2 males collected from the horse in Miyasaki (Japan), and in that of the Museum of Paris by 250 females and 6 males from Mauritius, and probably taken from cattle (for the collection includes also 3 large gravid females of *Hyalomma ægyptium*); further, 22 females and 1 male from Cayenne (where the peculiar characteristics of the variety are only slightly marked). I also thus determine a male and a female originally from the Senegal (coll. A. Railliet), and a male collected in Borneo from the deer (coll. R. Blanchard). Finally, I consider as belonging to this variety *Hæmaphysalis micropla* Can., found in South Chaco (Paraguay), on an undetermined mammal (Canestrini), and under the bark of the trees in Rio-Apa (Paraguay), by A. Balzan. The variety is noticeable because of the strength of the chitinous portions and especially because of the caudiform appendage of the male. The essential characteristics are the following:

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[1] SYNONYMY AND BIBLIOGRAPHY.

1887: ? *Hæmaphysalis micropla* CANESTRINI (1887), p. 104, pl. IX, figs. 3–5. [See also CANESTRINI, 1890, p. 493, placed in *Rhipicephalus*.—NEUMANN, 1897, pp. 408, 413, as syn. of *Rhipicephalus annulatus caudatus*.]

1890: ? *Rhipicephalus microplus* (Canestrini) CANESTRINI, 1890, p. 493.

1897: *Rhipicephalus annulatus caudatus* NEUMANN, 1897, pp. 413, 414, fig. 42. [See also STILES & HASSALL, 1901, p. 3.]

1899: *Rhipicephalus caudatus* (Neumann) FULLER, 1899, pp. 390, 391.

Female.—The projections on the posterior margin of coxæ I more marked, just outlined on pair II, less and less marked in the following pairs; in some cases (in the majority of specimens from Japan) five rows of denticles on each half of the hypostome.

Male.—Color darker. Eyes a little more distinct. Posterior margin of the body not festooned, but prolonged by a conical chitinous point in the direction of the median furrow, which ends a little in advance of the point, and is deeper [than that in the type]. Adanal shields more chitinous, dark brown, projecting. Teeth on the posterior margin of coxæ I much stronger. Hairs very much longer and very much more abundant.[1]

We have no specimens of this species and Canestrini's description is not accessible to us, hence we are not in a position to express a definite opinion concerning it. It may, however, be noted that a caudate form with eight rows of denticles on the hypostome (*Boophilus australis*) occurs in Venezuela and Argentina; also that Birula points out the resemblance of bis *Rh. calcaratus*, which has eight rows of denticles, to Canestrini's *Rh. microplus*. The possibility of the specific identity of *Rh. microplus* and *Rh. australis* does not therefore appear to be excluded. Against such identity, however, may be quoted Canestrini's statement (1890, p. 493) that the scutum of the male covers the entire body. The validity of the Japanese species, with ten rows of teeth, appears not to be without foundation.

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[1] Je rattache aussi à *Rhipicephalus annulatus*, à titre de variété (*Rh. annulatus caudatus*), une forme qui est représentée dans ma collection par 23 femelles et 2 mâles recueillis sur le Cheval à Miyasaki (Japon), et dans celle du Muséum de Paris, par 250 femelles et 6 mâles provenant de l'Ile de France et probablement pris sur le Bœuf (car le lot comprend encore trois grosses femelles pleines de *Hyalomma ægyptium*), plus 22 femelles et 1 mâle provenant de Cayenne (où les particularités de la variété sont peu accentuées). Je dispose aussi d'un mâle et d'une femelle originaires du Sénégal (collection A. Railliet), et d'un mâle pris à Bornéo sur un Cerf (coll. R. Blanchard). Enfin, je considère comme appartenant à cette variété *Hæmaphysalis micropla* Can., trouvé au Chaco méridional (Paraguay), sur un Mammifère indéterminé (Canestrini), et sous l'écorce des arbres à Rio-Apa (Paraguay), par A. Balzan. La variété se fait remarquer par le renforcement des parties chitineuses et surtout l'appendice caudiforme du mâle. Les particularités essentielles sont les suivantes:

Femelle.—Saillies du bord postérieur des hanches de la première paire mieux marquées, esquissées à la deuxième paire, de moins en moins aux suivantes; parfois (dans la plupart des spécimens du Japon), cinq files de dents sur chaque moitié de l'hypostome.

Mâle.—Teinte plus foncée. Yeux un peu plus apparents. Bord postérieur du corps non festonné, mais prolongé par une pointe conique, chitineuse, dans la direction du sillon médian, qui s'arrête un peu en avant d'elle et est plus profond. Ecussons adanaux plus chitineux, brun foncé, saillants. Dents du bord postérieur des hanches de la première paire bien plus fortes. Poils bien plus longs et bien plus abondants.

B.—EIGHT ROWS OF DENTICLES ON HYPOSTOME. MALE APPARENTLY WITHOUT TAIL, SIMILAR TO B. ANNULATUS.

The North African cattle tick.[1]

Mégnin (1880) determined as identical with *Ixodes Dugesii* Gervais, 1844, a species of tick from North Africa. Curtice (1892) pointed out the resemblance of this North African form to the North American species, and he and Neumann considered them specifically identical. This view is strongly supported by the description given by Mégnin, and from present knowledge it appears impossible to show good characters which would separate the two forms. At the same time we prefer to await further detailed comparison of specimens before either agreeing or disagreeing with Curtice and Neumann on this point. Mégnin's description reads as follows:

Characters common to both sexes.—Capitulum small and slightly salient, 0.60 mm. long, in shape of a blunt, very elliptical cone; palpi short, 0.30 mm. long, slightly shorter than the hypostome, slightly valvate, articles very distinct, the first one short, cylindrical, the two following irregularly polyhedric, the last small, cylindrical, infero-terminal; hypostome a little spatulate, with rounded extremity, and with eight rows of teeth, equal in each row; mandibles sliding each in a rough-skinned sheath, and terminated by an articulated harpoon, with four teeth in two groups, the two teeth of the lower group being larger than those of the terminal group. Legs six-jointed, coxæ oval, placated on the tegument, separated in the female, contiguous in the male; articles uniformly brown; tarsi cylindro-conical, with extremity dentated inferiorly in the two sexes, first pair mono-dentate, the others bidentate; terminated by an ambulacrum, the claws of which are twice as long as the pulvillum.

Fertilized female, young.—Six millimeters long, 2.50 mm. broad; body a pale red color, flattened, elongate, narrowed posteriorily, without festoons, presenting above and below the same furrows found in the females of other species. Scutum 1.20 mm. long, 1 mm. broad, rectangulo-pentagonal, narrow and short, with parallel lateral sides, posterior angle rounded, and with sinuous sides of a dull, chagrinous, brown-black color, strongly excavate in front, and in a square, for the articulation with the capitulum; eyes at the external and posterior angles of the scutum. Vulval pore and cutaneous striæ the same as in all females of *Ixodes*.

Fertilized female, replete.—Fourteen millimeters long, 8 mm. broad, body thick, elongate, slightly flattened, similar to a bean without the hilus, which would have parallel sides of a deep lead color, with longitudinal grooves or impressions similar to preceding species [*I. ægyptius*, *I. algeriensis*], but less pronounced.

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[1] SYNONYMY AND BIBLIOGRAPHY.

1880: "*Ixodes Dugesii* Gervais, 1844," of MÉGNIN, 1880, pp. 126, 127, fig. 44b.—NEUMANN, 1888, pp. 92, 93.—IDEM, 1892a, pp. 97, 98.—IDEM, 1892b, pp. 100, 101. [Given as syn. of *Boophilus bovis* by CURTICE, 1891a, p. 318.—IDEM, 1891b, p. 685.—IDEM, 1892c, pp. 243, 244.—MARX, 1892, p. 236.—OSBORN, 1896, p. 257.—MORGAN, 1899, p. 139.] [See also NEUMANN, 1897, p. 408, as syn. of *Rhipicephalus annulatus*.]

1894: "*Ixodes Dugesi* Gervais" of DOLLY, 1894, p. 1000, as syn. of *Boophilus bovis*.

Male.—Three and five-tenths millimeters long, 2.50 mm. broad, body subtriangular, angles and sides rounded, especially posteriorly. Scutum covering entire superior surface without leaving lateral clear margin; of a deep brown color, smooth, brilliant, and festooned posteriorly, each interval between the festoons being continued dorsally by a longitudinal sillon extending to the posterior quarter of the shield. Eyes simple, on the edge of the shield at the height of the second pair of legs. Ventral tegument pale, presenting on each side of the anus two pairs of arched chitinous plaques, of a deep-red color, narrow and equal. Genital pore round, chitinous, back of capitulum, at the height of legs II.

Nymph.—One to four millimeters long, 0.80 to 2.50 mm. broad; body oval; scutum, capitulum, and legs same size and form as in the larva, but having one pair of legs more, all darker color; stigmata present, no genital organs.

Larva.—Five-tenths of a millimeter long, 0.4 mm. broad, body flat, of orbicular form, slightly angular in front, color pale red, abdomen lighter; scutum cordiform, broad and short; capitulum similar to that of the adult, but smaller in every respect; legs shorter and more slender, tarsi not dentate. Genital organs, and respiratory stigmata absent.

Egg.—Fifty one-hundredths of a millimeter long, 0.40 mm. broad, ovoid, of deep yellow color, smooth, shining.[1]

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[1] *Caractères communs aux deux sexes.*—*Rostre* petit et peu saillant long de 0^{mm},60, en cône mousse très surbaissé; *palpes maxillaires* courts, longs de 0^{mm},30, un peu moins long que le dard maxillo-labial, peu valvés, à articles très distinct (fig. 44, B), le premier court, cylindrique, les deux suivants polyédriques irréguliers, le dernier petit, cylindrique, inféro-terminal; *dard maxillo-labial* un peu spatuliforme, à extrémité arrondie, à huit rangs de dents égales dans chaque rangée; mandibules glissant chacune dans une gaîne chagrinée, terminée par un harpon articulé à quatre dents en deux groupes, les deux du groupe inférieur plus grandes que celles du groupe terminal. Pattes à six articles, à hanches ovalaires plaquées sur le tégument, distantes chez la femelle, contiguës chez le mâle; articles uniformément bruns; tarses cylindro-coniques, à extrémité dentée inférieurement chez les deux sexes, mono-dentée à la première paire, bi-dentées dans les suivantes; terminée par un ambulacre dont les crochets dépassent de moitié la caroncule.

Femelle fécondée, à jeun.—Longue de 6^{mm}, large de 2^{mm},50; corps de couleur roux pâle, aplati, allongé, rétréci postérieurement sans trace de festons, présentant en dessus et en dessous les mêmes sillons déjà constatés chez les femelles des autres espèces. *Ecusson* long de 1^{mm},20, large de 1^{mm}, rectangulo-pentagonal, étroit et court à côtés latéraux parallèles, à angle postérieur arrondi et à côtés sinueux, d'une couleur brun-noire mate chagrinée, fortement échancré en avant et en carré pour s'articuler avec le rostre; yeux aux angles externes et postérieurs de l'écusson. Pore vulvaire et stries cutanées, comme chez toutes les femelles d'Ixodes.

Femelle fécondée, repue.—Longue de 14^{mm}, large de 8^{mm}, corps épais, allongé, un peu aplati, semblance à un haricot sans hile qui aurait les côtés parallèles, de couleur plombée foncée, avec des [p. 127] sillons ou impressions longitudinales comme dans les premières espèces mais moins prononcés.

Mâle.—Long de 3^{mm},50, large de 2^{mm},50, à corps subtriangulaire, à angles et côtés arrondis, surtout postérieurement. Ecusson recouvrant toute la face supérieure sans laisser de marge claire latéralement, de couleur brune foncée, lisse, brillant, et festonné postérieurement, chaque intervalle de feston se continuant supérieurement par un sillon longitudinal s'éteignant au quart postérieur de l'écusson. Yeux simples au bord de l'écusson à la hauteur de la deuxième paire de pattes. Téguments infé-

Rhipicephalus calcaratus[1] from Caucasus.

(Figures 156–166.)

Birula examined some ticks collected in Transcaucasus, Occidental Caucasus, and Ciscaucasus, which he described originally as *Ixodes calcaratus.* The original description is not accessible to us. Later (1895) he described them in detail, giving the following diagnosis and the figures here reproduced:

> Brownish red or yellowish brick color. Body elongate oval. Capitulum hexagonal, very broad. Eyes distinct, elliptical. Palpi very short, conical. Rostrum [hypostome] armed with 8 rows of teeth. Legs calcarate. Coxæ I bidentate. Dorsal porose warts [areas] small. Genital pore situated between coxæ I (♀) or II (♂). Stigmate areas subrotund, small. Male provided with four anal shields [clypei].

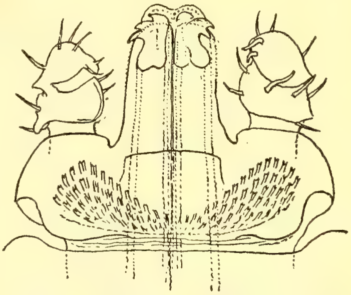

FIG. 156.—Capitulum of female *R. calcaratus.* After Birula, 1895, fig. 10.

> Body of the female, if replete, elongate oval, posterior portion back of spiracles narrower, sides of the anterior portion constricted four times at the legs and also at the spiracles, two poriferous dorsal rotund warts [areas] very small. Dorsal shield (scutum) provided with eyes, dispersely setulose, subpentagonal, length almost double the width, anterior angles slightly prominent, rotund, sides of the anterior portion of the scutum subparallel, posterior portion behind the eyes triangular, apex rounded, scarcely longer than the anterior part. Eyes elliptical, slightly convex, protruding very slightly from the edge of the

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rieurs pâles, présentant de chaque côté de l'anus deux paires de plaques chitineuses arquées, de couleur roux foncé, étroites et égales. Pore génital rond, chitineux, en arrière du rostre à la hauteur de la deuxième paire de pattes.

Nymphe.—Longue de 1 à 4^{mm}, large de 0^{mm},80, à 2^{mm},50; corps ovale, à écusson, rostre et pattes de même volume et de même forme que chez la larve mais ayant une paire de pattes de plus que celle-ci; le tout plus foncé; pas d'organes génitaux, mais des stigmates.

Larve.—Longue de 0^{mm},50, large de 0^{mm},40, corps aplati de forme orbiculaire, un peu anguleux en avant, de couleur roux pâle, l'abdomen plus clair; écusson cordiforme large et court; rostre semblable à celui des adultes, mais plus petit en tous sens; pattes plus courtes et plus grêles, à tarse non denté. Pas d'organes génitaux, ni de stigmates respiratoires.

Œuf.—Long de 0^{mm},50, large de 0^{mm},40, ovoïde, de couleur fauve foncée, lisse, luisant.

Habitat.—Nous avons recueilli cet Ixode en abondance sur des moutons barbaresques et touaregs, et sur des bœufs d'Algérie et du Maroc amenés à l'abattoir militaire de Vincennes. Nous l'avons aussi recueilli sur des bœufs sardes et sur des bœufs auvergnats. Les deux sexes s'y trouvaient fréquemment accouplés et quelques nymphes y étaient mélangées aux adultes.

[1] SYNONYMY AND BIBLIOGRAPHY.

(?): *Ixodes calcaratus* BIRULA (Russian article not accessible).—Travaux de la Soc. de Natur. de St. Petersbourg, XXIV, l. 2, p. 137 (not accessible).

1895: *Rhipicephalus calcaratus* (Birula) BIRULA, 1895, pp. 361–363, Tav. II, figs. 10–20. [See also NEUMANN, 1897, p. 408, as syn. of *Rhipicephalus annulatus.*]

shield, facing outward. *Capitulum* short and broad (almost twice as broad as long), frontal portion hexagonal, lateral angles very prominent, postero-lateral margins perceptibly emarginate; margins, anterior nearly straight, posterior arched; posterior portion of the capitulum constricted like a neck, equal in length to the frontal portion; ventrally the posterior margin of the capitulum is almost semicircular, no posterior angles, situated in the anterior emargination of the breast. Frontal areas densely porose, ovate, moderately large, placed obliquely on the posterior superficial portion of the capitulum. Palpi and rostrum [haustellum] attaining almost the length of the frontal portion of the head. *Rostrum* [haustellum] slightly longer than the palpi, broad and short, incised at the apex, no apical granulated portion, teeth [denticles] rhomboidal, obtuse, 8 rows (9–10 denticulate series not attaining the base). Hooks of the mandibles: Narrower ones bidentate, broader ones bidentate or tridentate. Palpi very short, subconical, spiniferous; first article very small, hidden under the anterior margin of the capitulum; second article pedunculate, in the dilated part a sharp transverse ridge, drawn out in an angle at the external margin, provided with an internal dilated margin, anterior portion dilated, armed beneath on the internal margin with several short and very strong spines; third article smaller than the preceding, subtriangular, internal margin rounded, spiniferous, arched posteriorly, external angles acute. Legs short, subequal, first tarsi unicalcarate, the others bicalcarate (the apical spur being twice as long and strong), robust and long spines located on the internal margin. First coxæ subtriangular, sparsely setose above, provided on the posterior margin with two very short blunt teeth (rounded at the apex); coxæ II and III elongate rotund, posterior margin incised; coxæ IV subquadrate, with angles rounded or nearly elongate-rotund. Auditory vesicle of the I tarsi ovate, with distinct internal hairs; proximal and distal of the vesicle the external margin is provided with chitinous indurations, of which the distal (apical) seen from the side of the tarsus is smaller, conical, the apex scarcely dilated, the proximal (basal) is pedunculate (the pedicle being short and thick) and provided with a head at the apex. Genital pore very small, situated between and a little below the I coxæ. Anal valve provided on both sides with four spines, arranged in a triangle. Spiracle areas very small, one-half as large as the posterior coxæ, ellip-

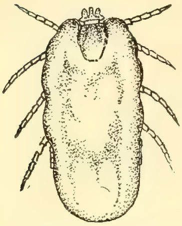
FIG. 157.—Dorsal view of female *R. calcaratus*. After Birula, 1895, fig. 11.

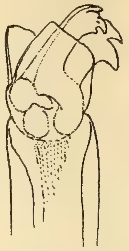
FIG. 158.—End of mandible of female *R. calcaratus*. After Birula, 1895, fig. 12.

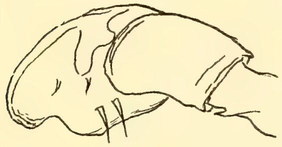
FIG. 159.—Coxa I of female *R. calcaratus*. After Birula, 1895, fig. 13.

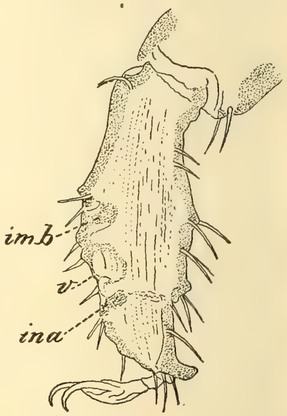

FIG. 160.—Tarsus I of female *R. calcaratus*: *v*, auditory vesicle; *imb*, basal chitinous callum; *ina*, apical chitinous callum. After Birula, 1895, fig. 14.

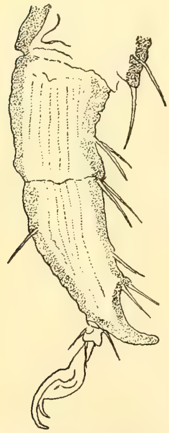
FIG. 161.—Tarsus IV of female *R. calcaratus*. After Birula, 1895, fig. 15.

tical. Length of body, 6.5 mm. (♀ replete); width, 3.5 mm.; length of I leg, 2 mm.; length of II leg, 2.5 mm.

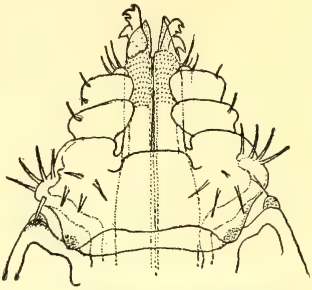

FIG. 162.—Dorsal view, capitulum of male *R. calcaratus*. After Birula, 1895, fig. 16.

Male similar in size and color to the nonreplete female, but dorsal shield provided with five constrictions above the legs and spiracle areas, anterior angles very prominent, and dentiferous; two external teeth (of which the superior is broader and half as long as the inferior), the internal single and small. Capitulum of the male slightly narrower and longer than in the female, provided with spiniferous angles on each side and an arched posterior margin. Palpi perceptibly shorter than the rostrum [haustellum]. Posterior margin of the body 7-lobed; all lobes rounded, by no means broad, especially median lobes narrower; ventral surface of the abdomen provided on each side of the anus with two shields, the median of which are larger, elongate, increasing in size posteriorly, but with narrower apex, which is obliquely abrupt toward the exterior; external angle rounded, internal angle prominent, posterior margin biincised, setiferous, provided with several apical tubercles; lateral shields smaller, elongate-triangular. Legs short, rather thick, setiferous; tarsi I unicalcarate, others armed with two subequal spurs; coxæ I subtriangular, decidedly narrower at the internal margin, posterior margin provided with two teeth (the inner smaller), and between these a rather deep incision, the surface and exterior angles setiferous; coxæ II subquadrangular, postero-internal angle more or less prominent; coxæ III and IV subquadrangular, angles rounded. Genital pore rather wide, situated between the second pair of coxæ. Otherwise like the female. Length of body, 2.5 mm.

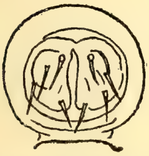

FIG. 163.—Anus of male *R. calcaratus*. After Birula, 1895, fig. 17.

It is very closely related to "*Rhipicephalo* (*Hæmaphysali*) *microplæ* (Canestrini)," but differs from it in having shorter legs, lobed posterior margin of the body, and bidentate coxæ; moreover, it inhabits other geographical regions.[1]

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[1] [p. 361] Brunneo-rufus vel fulvo-testaceus. Corpus elongato-ovale. Capitulum hexagonale, latissimum. Oculi distincti, elliptici. Palpi brevissimi, coniformes. Rostrum dentibus 8-seriatis armatum. Pedes calcarati. Coxæ I bidentatæ. Verrucæ dorsales porosæ [p. 362] parvæ. Rima genitalis inter coxas I (♀), vel II (♂), posita. Areolæ stigmaticæ subrotundæ, parvæ. Mas clypeis pygealibus quattuor auctus.

Feminæ corpus, si repletum, elongato-ovale, parte postica pone spiracula angustiore, partis anticæ lateribus ad pedes nec non ad spiracula quater coarctatis, verrucis poriferis dorsalibus duabus rotundis minimis. *Scutum dorsale* oculiferum, disperse setulosum, subpentagonum, latitudine fere duplo longius, angulis anticis parum prominentibus, rotundatis, lateribus partis scutuli anticæ subparallelis, parte postica pone oculos triangulari, apice rotundata, quam pars antica haud longiore. *Oculi* elliptici, parum convexi, a margine scuti vix distantes, extrorsum spectantes. *Capitulum* breve ac latum (longitudine fere duplo latius), parte frontali hexagonali, angulis lateralibus valde prominentibus, marginibus postico-lateralibus sensim emarginatis, marginibus antico subrecto, postico arcuato; capituli parte postica colliformiter coarctata, longitudini partis frontalis æquali; subtus margine capituli postico fere semicirculari, angulis posticis nullis, in sterni emarginatura antica sito. *Areæ frontales* crasse porosæ, ovatæ, sat magnæ, in capituli superficie postica oblique dispositæ. *Palpi rostrumque* longitudinem partis frontalis capituli fere attingentes. *Rostrum* palpis paulo longius, latum ac breve, apice incisum, parte granulata apicali nulla, dentibus rhomboidalibus

Neumann (1897) considered this species identical with the North American form. In this he may be correct, but we prefer to await a comparison of specimens before accepting the determination as definite. Certain characters mentioned by Birula appear to us to render Neumann's opinion at least debatable.

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obtusis 8-seriatis (seriebus 9–10 denticulatis basin non attingentibus). *Mandibularum unci* angustiores bidentati, latiores bi-vel tridentati. *Palpi* brevissimi, subconiformes, spiniferi; articulis I minimis, sub margine capituli antico latentibus; secundis pedunculatis, in parte dilatata crista acuta transversa, ad marginem externum anguliformiter producta, instructis margineque interno dilatato præditis, parte antica dilatata, subtus in margine interno spinis nonnullis valde robustis brevibusque armata; tertiis articulis præcedentibus minoribus, subtriangularibus, margine interno rotundato, spinifero, postico arcuato, angulis externis acutis. *Pedes* breves subæquales, tarsis I unicalcaratis, ceteris calcaribus duobus (quorum calcar apicale duplo longius et robustius) armatis, margine interno spinis robustis ac longis obsitis. *Coxæ* I subtriangulares, superne sparsim setosæ, margine postico dentibus duobus brevissimis, apice rotundatis, præditæ; coxæ II et III elongato-rotundatæ margine postico inciso; coxæ IV subquadratæ, angulis rotundatis, vel fere elongato-rotundatæ. Tarsorum I *vesica auditiva* ovata, pilis internis distinctis; ante ac pone vesicam margine externo callis chitineis prædito, quorum apicali (anticum), a latere tarsi visu, minore, coniformi, apice vix dilatato, basali (posticum) pedunculato (pedunculo brevi ac crasso) et ad apicem capitato. *Rima genitalis* minima, inter (et paulo inferius) coxas I posita. *Valva analis* utraque spinis 4 triangulariter [p. 363] dispositis instructa. *Spiraculorum areola* minima (coxis posticis duplo minor), elliptica.

Long. corporis = 6½ mm. (♀ repletæ).
Latit. corporis = 3½ mm.
Long. pedum I = 2 mm.
Long. pedum II = 2½ mm.

Mas *corporis statura* coloreque feminæ non repletæ similis, sed *scuto dorsali* coarctationibus quinque supra pedes ac areolas prædito, angulis anticis valde prominentibus, dentiferis: dentibus externis duobus (quorum dens superior latior ac dente inferiore duplo brevior), interno singulo ac parvo. *Capitulum maris* paulo angustius ac longius quam in femina, utrinque angulis spiniferis et margine postico arcuato ornatum. *Palpi* rostro evidenter breviores. Corporis *margo posticus* 7-lobatus: lobis omnibus rotundatis, haud latis, præterea lobis mediis angustioribus; abdominis superficies inferior ad anum utrinque clypeis pygealibus duobus prædita, quorum medii—majores, elongati, retrorsum gradatim dilatati, sed apice angustiore et oblique ad externum abrupto, angulo externo rotundato, interno prominente, margine postico bis inciso, setifero, tuberculis nonnullis apicalibus prædito; clypei laterales minores, elongato-triangulares. *Pedes* breves sat crassi, setiferi; tarsis I unicalcaratis, ceteris calcaribus duobus subæqualibus armatis; coxis I subtriangularibus ad marginem internum conspicue angustioribus, margine postico dentibus duobus (interno minore) et inter hos incisura sat profunda prædito, superficie et angulis externis setiferis; coxis II subquadrangularibus, angulo interno postico plus minusve prominente, coxis III et IV subquadrangularibus, angulis rotundatis. *Rima genitalis* sat lata, inter coxas II posita.

Ceterum ut in femina.

Long. corporis = 2½ mm.

Rhipicephalo (*Hæmaphysali*) *microplæ* (Canestrini) valde affinis, sed pedibus brevioribus, corporis margine postico lobato coxisque bidentatis differt, præterea alias regiones geographicas incolat.

C.—SIX ROWS OF DENTICLES ON HYPOSTOME.

Rhipicephalus annulatus, var. from Buenos Aires.

Neumann (1897, p. 413) has mentioned a tick from Buenos Aires which is apparently closely related to, if not identical with, *Boophilus decoloratus*, agreeing with that form in possessing three rows of denticles on each half of the hypostome. Neumann says:

> *Varieties.*—One variety, insufficiently characterized because the male is lacking, is distinguished from the type only by the presence of three rows of denticles on each half of the hypostome. It is represented in the collection of the Museum of Hamburg by 59 replete females, brown red, from 6 to 10 mm. in length, from Buenos Aires.[1]

D.—NUMBER OF ROWS OF TEETH ON HYPOSTOME (?) MALE APPARENTLY WITHOUT TAIL.

Hæmaphysalis rosea,[2] from the West Indies.

(Figures 167,168.)

In 1844, Koch described a West Indian tick as a new species, *H. rosea*. Curtice and Neumann have expressed the opinion that this is identical with the North American form, *Boophilus annulatus*. Possibly they are correct in this view, but a positive opinion on the subject can not be given. Koch's (1844, p. 237) original description reads:

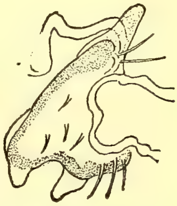

FIG. 164.—Coxa I of male *R. calcaratus*. After Birula, 1895, fig. 18.

> *Hæmaphysalis rosea: Male.*—Oval, posteriorly somewhat narrow, very shining, indistinctly very finely punctate, posteriorly three longitudinal grooves side by side, yellow red, almost rose red. Legs yellow. Length seven-eighths line.
>
> *Female.*—Thorax elongate, blood red, anteriorly in middle field a fiery red spot; replete body very large, with the same longitudinal grooves, reddish olive color. Legs somewhat darker yellow. Length 2¾ lines.
>
> *Habitat.*—West Indies.[3]

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[1] *Variétés.*—Une variété, insuffisamment caractérisée par défaut de mâle, ne se distingue du type que par la présence de trois files de dents sur chaque moitié de l'hypostome. Elle est représentée dans la collection du Muséum de Hambourg par 59 femelles repues, brun rouge, de 6 à 10 millimètres de longueur et provenant de Buenos Aires.

[2] SYNONYMY AND BIBLIOGRAPHY.

1844: *Hæmaphysalis rosea* KOCH, 1844, p. 237; type locality, West Indies.—IDEM, 1847, pp. 25, 121, 122, Tav. XXVI, figs. 95, 96.—MURRAY, 1877, p. 200, figs. 2. [Given as syn. of *Boophilus bovis* by CURTICE, 1891a, p. 318.—IDEM, 1891b, p. 685.—IDEM, 1892c, p. 243.—MARX, 1892, p. 236.—DOLLY, 1894, p. 997.—OSBORN, 1896, p. 257.—MORGAN, 1899, p. 139.] [See also NEUMANN, 1897, p. 408, as syn. of *Rhipicephalus annulatus*.]

[3] *H. rosea.* Eiförmig, hinten etwas schmal, sehr glänzend, undeutlich sehr fein gepünktelt, hinten drei Längsgruben nebeneinander, gelbroth, fast rosenroth. Beine gelb. Länge ⅞ '''. Männchen.

Thorax länglich, blutroth, vorn im Mittelfelde ein Fleck feuerroth, Hinterleib vollgesogen sehr gross, mit denselben Längsgruben, röthlich-olivenfarbig. Beine etwas dunkler gelb. Länge 2¾ '''. Weibchen.

Vaterland: Westindien.

In his more extensive paper, published three years later, Koch (1847, p. 121) again refers to this form, giving two illustrations (copied as figs. 167, 168, in this paper), together with the following diagnosis and description:

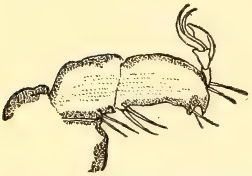

FIG. 165.—Tarsus IV of male *R. calcaratus*. After Birula, 1895, fig. 19.

Male.—Oval, very shining, posteriorly with three longitudinal grooves; yellow red; mouth shield [capitulum] reddish; palpi and legs yellow.

Female.—Head shield [scutum] elongate, blood red, anteriorly in the middle field a fiery red spot; mouth shield [capitulum], palpi, and legs as in the male; body very large, fallen in dorsally, with the same three longitudinal grooves.

Length of male seven-eighths line, of replete female $2\frac{1}{4}$ to $2\frac{3}{4}$ lines.

The outline of the male tick is quite oval, still somewhat narrow posteriorly and on the posterior margin somewhat bluntly round; the surface is very finely, indistinctly, almost somewhat wrinkly punctate and very shining; in front of posterior margin are found three longitudinal grooves, of which the middle one is longer than the lateral and gutter shaped; anterior of this in the middle, two depressions and a shallow depression back of each of the two very fine small curved grooves of the indistinct head shield [scutum]. Mouth shield [capitulum] and palpi are small, the legs moderately long.

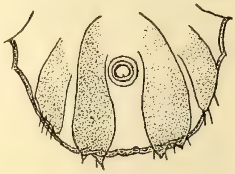

FIG. 166.—Ventral view posterior portion of male *R. calcaratus*. After Birula, 1895, fig. 20.

The color of the body is a brownish yellow red, bordering on the menning-red, darker in the middle of the back than on the sides. The mouth shield [capitulum] is lighter, reddish yellow. Palpi and legs are yellow. The replete female is broader anteriorly than posteriorly, rounded posteriorly, the outline being quite that of the sole of a shoe, on the back somewhat flat and almost fallen in, so that the lateral margins are perceptibly raised above the surface; the longitudinal grooves remain quite the same as in the male. The head shield [scutum] is narrow; elongate heart-shaped, convex, pin-point finely punctate, blood red, almost dark-varnish red, with a fire-red spot anteriorly on the middle field merging into the ground color. The body is reddish olive color. Mouth shield [capitulum], palpi, and legs are yellow, the latter somewhat darker than in the male.

Three specimens, a male and two females, both the latter replete.

Habitat.—West Indies.[1]

It will be noticed that Koch gives neither the host nor the exact type locality.

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[1] Eiförmig, sehr glänzend, hinten mit drei Längsgruben; gelbroth; Mundschild röthlich; Taster und Beine gelb. Männchen.

Kopfschild länglich, blutroth, vorn im Mittelfelde ein Fleck feuerroth; Mundschild, Taster und Beine wie oben; Hinterleib sehr gross, auf dem Rücken eingefallen, mit denselben drei Längsgruben. Weibchen.

Länge des Männchens $\frac{7}{8}'''$, des vollgesognen Weibchens $2\frac{1}{4}$ bis $2\frac{3}{4}'''$.

Koch. Arch. f. Naturgesch. X. I. p. 237, n. 1.

Dem Umrisse nach ist die männliche Zecke ziemlich eiförmig, doch hinten etwas schmal und am Hinterrande [p. 122] etwas stumpf rund; die Fläche ist sehr fein, undeutlich, fast etwas runzelig punktirt und sehr glänzend; vor dem Hinterrande befinden sich drei Längsgruben, davon die mittlere länger als die aüssern und rinnen-

Genus Dermacentor[1] Koch, 1844.

Generic diagnosis.—*Ixodidæ. Rhipicephalinæ:* Eyes present. Base of capitulum rectangular; broader than long. Dorso-submedian porose plates present. Palpi short and thick. Stigmal plate comma-shaped; short. Male without anal shields. Coxæ I bidentate in both sexes; coxæ IV of male much larger than I to III. Scutum usually ornamented.

Type species.—*Dermacentor reticulatus* (Fabricius, 1794.)

Neumann's key to the species of this genus appears to us somewhat difficult to use and likely to lead one astray in determinations. As only four species are at our disposal at present, and two of these may perhaps be specifically identical, we refrain from an attempt to revise the entire key.

Key to Four American Species of the Genus Dermacentor.

[For forms reported in the United States, follow Roman type.]

1. Stigmal plate finely punctate .... *D. electus,* p. 455
   Stigmal plate coarsely punctate 2
   Stigmal plate with 8 to 40 large circular structures (figs. 215, 217), *each surrounded by fine punctations.* Porto Rico, *on horses* .... *D. nitens.*
2. Parasitic on cattle .... *D. reticulatus,* p. 448
   Parasitic on the wapiti .... *D. variegatus,* p. 452

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förmig, vor dieser, auf der Mitte, zwei Eindrücke, und ein seichter Eindruck hinter jedem der zwei sehr feinen Curvengrübchen des undeutlichen Kopfschildes. Mundschild und Taster sind klein, die Beine mässig lang.

Die Körperfarbe ist ein bräunliches Gelbroth, sich dem Mennigrothen nähernd, auf der Mitte des Rückens dunkler als an den Seiten. Der Mund ist heller, röthlichgelb. Die Taster und Beine sind gelb. Das vollgesogene Weibchen ist vorn breiter als hinten, am Hinterrande gerundet, dem Umrisse nach ziemlich schuhsohlenförmig, auf dem Rücken etwas flach und fast eingefallen, so dass die Seitenränder sich merklich über die Fläche erheben; die Längsgruben bleiben ziemlich dieselben wie bei dem Männchen. Der Kopfschild ist schmal; länglich herzförmig, gewölbt, nadelrissig fein punktirt, blutroth, fast dunkellackroth, mit einem feuerrothen, in die Grundfarbe übergehenden Fleck vorn auf dem Mittelfelde. Der Körper ist röthlicholivenfarbig. Mundschild, Taster und Beine sind gelb, letztere etwas dunkler als beim Männchen.

Drei Exemplare, ein Männchen und zwei Weibchen, beide letztere vollgesogen.

Vaterland: Westindien.

[1] Synonymy and Bibliography.

1844: *Dermacentor* Koch, 1844, pp. 235–237.—Idem, 1847, pp. 24, 25, 109–121.—Fürstenberg, 1861, p. 208.—Murray, 1877, pp. 187, 199.—Canestrini, 1890, pp. 483, 487, 488, 489, 490, 491, 493, 519–523.—Idem, 1892, p. 581.—Marx, 1892, pp. 233, 236.—Railliet, 1893, pp. 713, 714.—Osborn, 1896, p. 261.—Oudemans, 1896, p. 191.—Neumann, 1897, pp. 325, 326, 360–384.—Morgan, 1899, p. 139.—Ward, 1900a, pp. 200, 201.—Idem, 1900b, p. 436.—Salmon & Stiles, 1901, pp. 447–456.

1882: *Pseudixodes* Haller, 1882, pp. 311, 312 (type, *holsatus*). [See also Canestrini, 1890, p. 485.—Neumann, 1897, p. 360, as syn. of *Dermacentor.*]

1894: "*Dermacenter*" of Francis, 1894, p. 451 (misprint for *Dermacentor*).

1899: "*Dermocenter*" of Lewis, 1899, p. 3 (misprint for *Dermacentor*).

Neumann's key is here added, as it contains other forms:

KEY TO THE SPECIES OF THE GENUS DERMACENTOR.[1]

[For forms reported in the United States, follow Roman type.]

Females 1
Males 5

A.—Female.

1. Scutum marked with white spots 2
Scutum marked with red or yellow spots 4
Scutum not marked with light spots, blackish (Porto Rico) .... *D. nitens.*
2. Scutum nearly as broad as long; second palpal article with dorsal retrograde prolongation .... *D. reticulatus*, p. 448
Scutum longer than broad; second palpal article without prominent dorsal retrograde prolongations 3
3. Body oval; hairs few .... *D. electus*, p. 455
Body oblong; hairs abundant .... *D. variegatus*, p. 452
4. *Scutum nearly covered with light spots* (Africa) .... *D. rhinocerotis.*
Scutum with three spots arranged in a triangle (Congo) .... *D. circumguttatus.*

B.—Male.

5. Scutum marked with white spots 6
Scutum marked with red or yellow spots 8
Scutum of uniform color, without spots 9
6. Second palpal article very much swollen laterally, with dorsal retrograde spine .... *D. reticulatus*, p. 448
Second palpal article slightly swollen laterally, without dorsal retrograde spine 7
7. Body oval .... *D. electus*, p. 455
Body triangular .... *D. variegatus*, p. 452
8. *Spots on scutum symmetrical; one large arrow-shaped spot anteriorly, representing a pseudo-scutum* (Africa) .... *D. rhinocerotis.*
Four pairs of symmetrically arranged spots on scutum; pseudo-scutum absent (Congo) .... *D. circumguttatus.*
9. *Scutum pubescent; palpi not swollen* (Porto Rico) .... *D. nitens.*
Scutum glabrous; palpi swollen laterally (Syria) .... *D. parvus.*

THE NET TICK (*Dermacentor reticulatus*).[2]

(Figures 61, 169–177.)

SPECIFIC DIAGNOSIS.—*Dermacentor:* Stigmal plate coarsely punctate.

Male.—Body same form and dimensions as young female, occasionally larger. Scutum deep reddish brown, but concealed for the most part by a silver white

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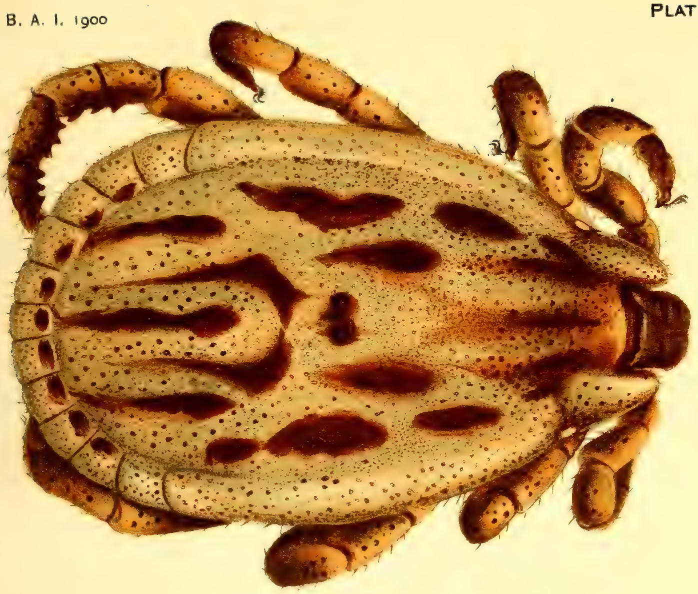
[1] The following species are not included in this key: *D. puncticollis, dentipes, clathratus, parabolicus, cruentus;* all Koch, none American. *D. planus* Rudenow. *D* *Feai, auratus, indicus, longipes* Supino; apparently not American.

[2] SYNONYMY AND BIBLIOGRAPHY.

1794: *Acarus reticulatus* FABRICIUS, 1794, p. 428. [See also LATREILLE, 1804, p. 52; RAILLIET, 1893, p. 713, and NEUMANN, 1897, p. 360, as syn. of *Dermacentor reticulatus.*—FABRICIUS, 1805, p. 355, as syn. of *Ixodes reticulatus.*]

1806: *Ixodes reticulatus* (Fabricius) FABRICIUS, 1805, p. 355.—LATREILLE, 1806, p. 157.—IDEM, 1829, p. 288.—ILLIGER, 1807, p. 369.—MOQUIN-TANDON, 1861, p. 303. [See also GERVAIS, 1844, p. 240, as syn. of *Ixodes pictus.*] [See also



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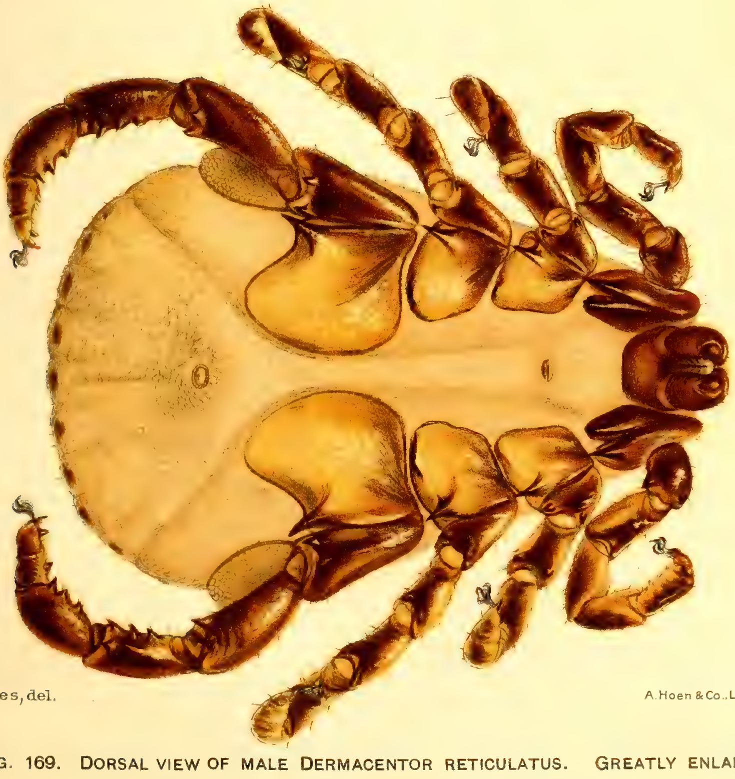

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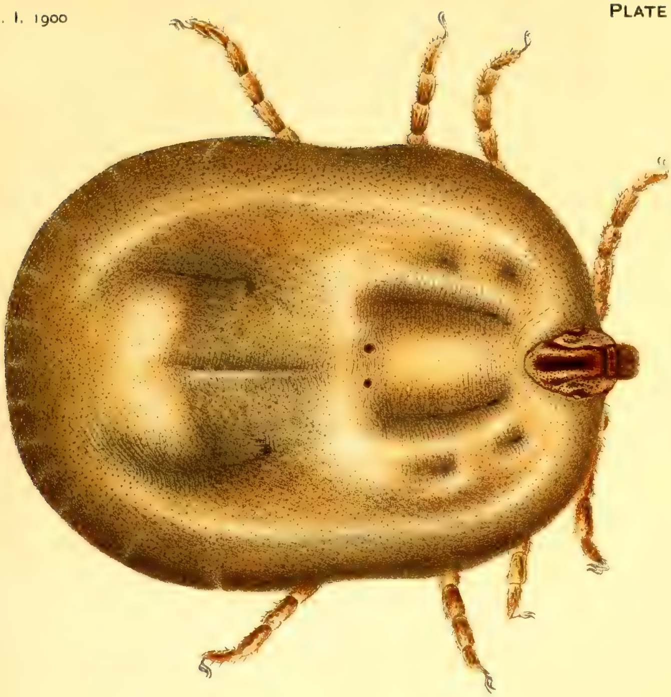
FIG. 169. DORSAL VIEW OF MALE DERMACENTOR RETICULATUS. GREATLY ENLARGED. ORIGINAL FROM LIFE. B. A. I., 3179; OKLAHOMA.

FIG. 170. VENTRAL VIEW OF SAME.

171



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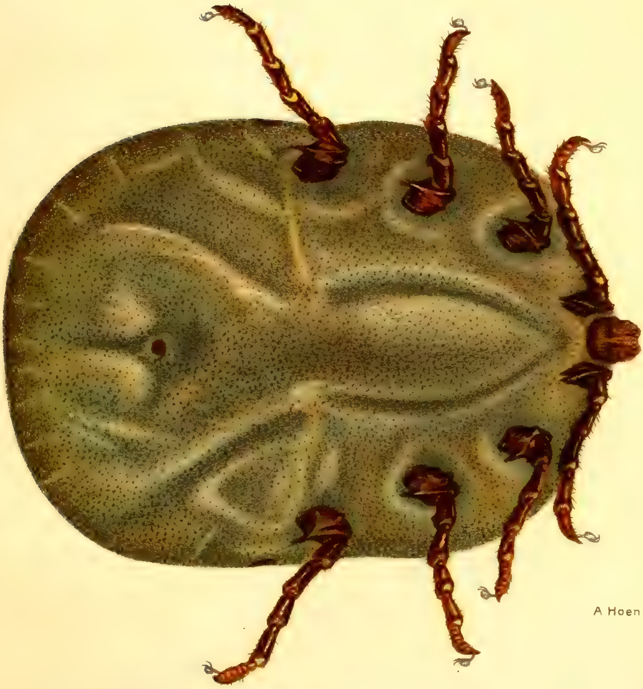

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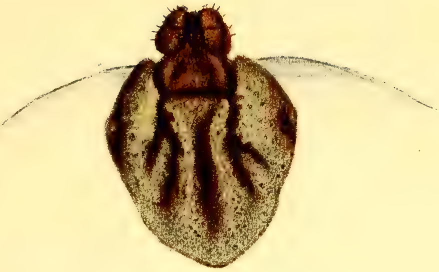
FIG. 171. DORSAL VIEW OF FEMALE DERMACENTOR RETICULATUS. GREATLY MAGNIFIED. ORIGINAL FROM LIFE. B. A. I., 3179.

FIG. 172. VENTRAL VIEW OF SAME.



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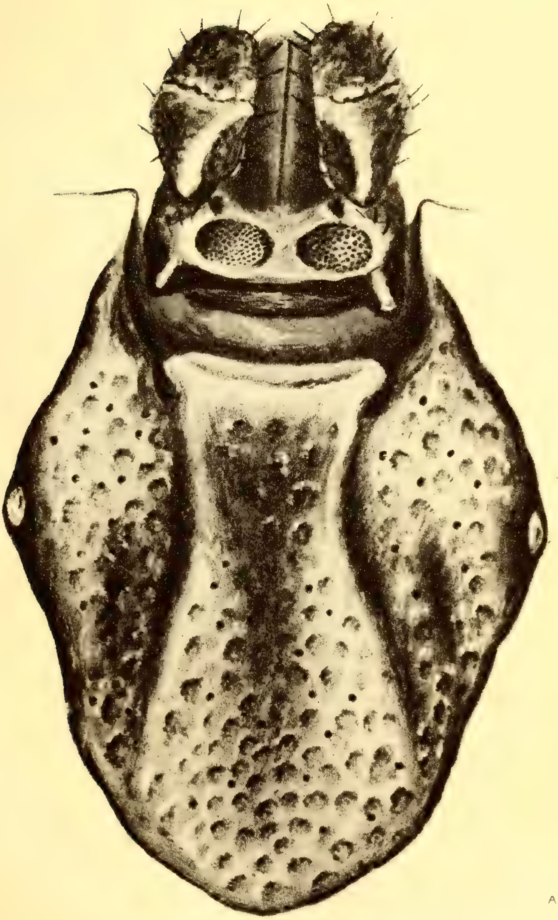

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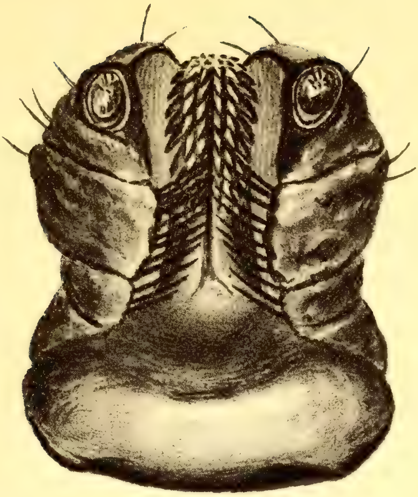
FIG. 173. SCUTUM AND CAPITULUM OF FEMALE DERMACENTOR RETICULATUS. GREATLY ENLARGED. ORIGINAL. B. A. I., 2998.

FIG. 174. DORSAL VIEW OF SAME.



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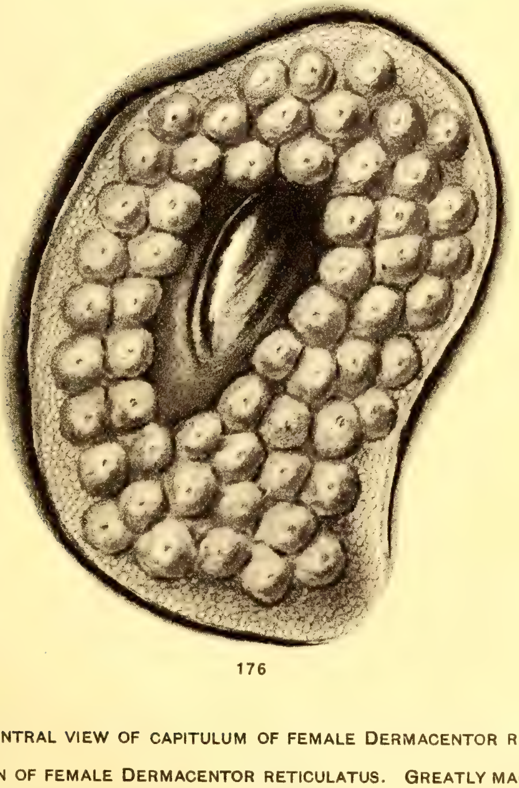

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FIG. 175. VENTRAL VIEW OF CAPITULUM OF FEMALE DERMACENTOR RETICULATUS.

FIG. 176. STIGMEN OF FEMALE DERMACENTOR RETICULATUS. GREATLY MAGNIFIED TO SHOW WART-LIKE PUNCTATIONS. ORIGINAL. B. A. I.. 2998.

metallic rust with rose and green tinges; anteriorly an ellipitical spot (pseudoscutum), very nearly representing in form and color the shield of the female, limited by a white border; then a median spot, a sort of center from which radiate white lines which border four anterior elongate brown spots arranged in an arc; three posterior elongate spots, the median spot being the larger, the two lateral spots may be somewhat semicircular. A marginal groove similar to that of the young female, limiting a border which is larger caudad, alternately marked with white and brown, and divided posteriorly into 11 distinct dorsal festoons; the white rust is occasionally almost effaced in the posterior half. Punctations are present on entire surface as in female. Ventral surface similar to that of the young female, except for the characters resulting from the form of the coxæ. Stigmata somewhat comma-form, a little more elongated. Capitulum differs from that of the female as follows: Length, 650 to 825 μ; base longer, square or slightly longer than broad or slightly broader than long.[1] Mandibles 1.1 to 1.4 mm. long, digit 130 to 150 μ; internal apophysis elongated transversely, with straight base, tooth large and bifide; external apophysis bidentate, terminal tooth subventral and small, the other very large. Denticles of

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Conil, 1877, p. 27; Railliet, 1893, p. 713, and Neumann, 1897, p. 360, as syn. of *Dermacentor reticulatus.*]

1826: *Ixodes marmoratus* Risso, 1826, pp. 182, 183.—Mégnin, 1880, p. 132.—Neumann, 1888, p. 93.—Idem, 1892a, p. 98.—Idem, 1892b, p. 101.—Perroncito (18—), p. 489.—Dolly, 1894, p. 1000. [See also Railliet, 1893, p. 713, and Neumann, 1897, p. 360, as syn. of *Dermacentor reticulatus.*]

1844: *Dermacentor reticulatus* (Fabricius) Koch, 1844, p. 235.—Idem, 1847, pp. 110–112, pl. xxiii, figs. 85, 86.—Canestrini, 1890, pp. 479, 485, 489, 519–523, Tav. xli, fig. 4; xlii, fig. 3.—Railliet, 1893, pp. 713, 714.—Osborn, 1896, p. 262.—Neumann, 1897, pp. 360–365, 366, 367, 368, 369, 370, 381, 383, figs. 20, 21.—Ward, 1900a, p. 200.—Stiles & Hassall, 1901, p. 3.—Salmon & Stiles, 1901, pp. 448–452, figs. 61, 169–177.

1844: *Dermacentor albicollis* Koch, 1844, p. 236.—Idem, 1847, pp. 113, 114, pl. xiv, fig. 88. [See also Neumann, 1897, p. 360, as syn. of *Dermacentor reticulatus.*]

1844: *Dermacentor pardalinus* Koch, 1844, p. 235.—Idem, 1847, pp. 114, 115, pl. xxiv, fig. 89.—Murray, 1877, p. 199, figs. 2. [See also Neumann, 1897, p. 360, as syn. of *Dermacentor reticulatus.*]

1844: *Dermacentor ferrugineus* Koch, 1844, p. 236.—Idem, 1847, pp. 118, 119, pl. xxv, fig. 92. [See also Neumann, 1897, pp. 360, 364, as syn. of *Dermacentor reticulatus.*]

1857: "*Ixodes holsatus* (Fabricius)" of Kolenati, 1857, p. 24, pl. ii. [See also Neumann, 1897, p. 360, as syn. of *Dermacentor reticulatus.*]

1871: *Ixodes 5-striatus* Fitch, 1871, p. 366; type locality, Virginia.

1882: *Pseudixodes* "*holsatus* (Fabricius)" Haller, 1882, pp. 311, 312, pl. v, fig. 5. [See also Canestrini, 1890, pp. 485, 526, as doubtful syn. of *Hæmaphysalis punctata,* and Railliet, 1893, p. 714.—Neumann, 1897, pp. 360, 364, as syn. of *Dermacentor reticulatus.*]

1887: *Hæmaphysalis marmorata* Berlese, 1887, fasc. xlvii, No. 4. [See also Neumann, 1897, p. 360, as syn. of *Dermacentor reticulatus.*]

1892: "*Dermacentor occidentalis* Marx, the Western deer tick," in Curtice, 1892b, pp. 226, 234.—Idem, 1892c, p. 237.—Railliet, 1893, p. 714 (of California).—Morgan, 1899, p. 134.—Ward, 1900a, p. 200. [See also Neumann, 1897, p. 365, as syn. of *Dermacentor reticulatus.*] [Not "*Dermacentor occidentalis* Marx" of Niles, 1898b, pp. 28, 29, 30, pl. iv, figs. 1, 2, *Amblyomma.*]

1897: *Dermacentor venustus* Marx in Neumann, 1897, p. 365, as syn. of *Dermacentor reticulatus.*

[1] In all specimens at our disposal at present, it is slightly broader than long.

the hypostome disposed in only three rows each side. Palpi extending beyond hypostome by scarcely a third of the length of the third article; first article longer, second and third shorter than in the female; dorsal retrograde point of second article may be quite pronounced, especially on large specimens. Coxæ increase in size from I to IV, their median border parallel to median line of body; coxæ of right and left sides are very close; coxæ IV very large, at first twice afterwards (in the adult) three times the size of the III pair, their median half greatly prolonged posteriorly, may extend to the plane of the posterior extremity of the peritremes; prominences same as in female. Two spines each on tarsi II to III; three spines on coxæ IV; ventral border of IV femur, tibia, and protarsus trispinate.

Young female.—Body depressed, with oval contour, broader posteriorly than anteriorly, 5 mm. long by 2.5 mm. broad; color, reddish brown, except the dorsal shield; capitulum, legs, and margin of superior surface somewhat lighter; scutum very large, extending posteriorly to the niveau of the insertion of the III pair of legs, with elliptical outline, slightly sinuous, with an anterior emargination limited by two blunt projecting angles; cervical grooves concave laterally, transformed into deep fossettes at their posterior extremity; two kinds of punctations; some large, numerous especially on the sides, the others very fine, numerous on entire surface; color, milk white, or in some live specimens silver white, with iridescent rose to green, covering occasionally entire shield except the grooves, the punctations and a median, poorly limited, longitudinal spot, even extending over a part of the dorsal base of the capitulum and the palpi; at other times accentuated more on the borders, becoming weaker as it elongates, and allowing the deep brown red to appear. Eyes pale brown, situated a little anterior of the middle of the lateral margin. Dorsal surface of the abdomen with a marginal groove commencing back of the eyes, and three longitudinal grooves extending caudad to the marginal groove, the two laterals commencing near the posterior border of the scutum, the median some distance farther; some irregular wrinkles. Posterior margin, beginning at the stigmata, is divided into eleven festoons; lateral festoons larger than the median. Punctations scattered in irregular longitudinal series on the entire surface. These punctations are numerous, of unequal size, and the largest bear short hairs; ventral surface also provided with fine hairs; genital pore at height of coxæ II; sexual grooves very close together in their anterior portion, then diverging very sharply back of coxæ IV and terminating between the second and third anterior festoons of the posterior margin. Ano-marginal groove relatively short. Anus with very short hairs on its anterior border. Stigmal plate comma-shape, short, with truncated point, rounded. Capitulum 720 μ long (from its posterior dorsal border to the extremity of the hypostome), each posterior lateral angle prolonged into a short point; porose areas circular; mandibles 1.1 mm. long, the digit measuring 150 μ. Internal apophysis of digit with large base and strong posterior tooth; external apophysis with three successive teeth, one terminal, a little subcentral, the second larger, the third still larger. Hypostome spatulate; anterior denticles numerous and very small; proximal denticles very strong, on each

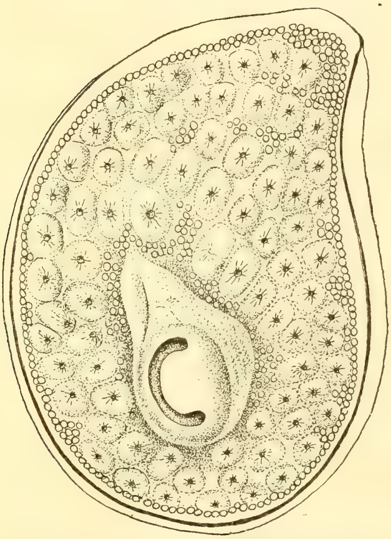

FIG. 177.—Stigmen of another specimen of *Dermacentor reticulatus;* female from Tennessee. Greatly enlarged, showing structure. Original. B. A. I. Coll. 3206.

side in four,[1] then in three longitudinal rows of ten to eleven each; the denticles of each transverse row being equal, diminishing gradually in size proximally, and finally becoming squamiform. Palpi noticeably longer than hypostome, which they overreach in front by about one-half of their third article, almost as broad as long; first article short and annulate; second and third articles larger, convex laterally, decidedly valvate; all three articles provided with strong bristly barbed hairs on their ventro-internal border; postero-dorsal border of the second article prolonged in a blunt retrograde point of variable length, extending over the dorsal surface of the first article; dorsal surface of third article triangular; fourth article small, cylindrical, infero-terminal. Legs of average length, coxæ slightly longer than broad; coxæ I decidedly bidentate; coxæ II to IV with a rather strong spur on the middle of their posterior edge. Long hairs on all the articles, coxæ included, especially on the ventral edge, which is rather festooned by their insertions. A strong recurved, terminal spine on tarsi II–IV, feeble on the pair I; pulvillum attaining nearly the length of the middle of the hooks.

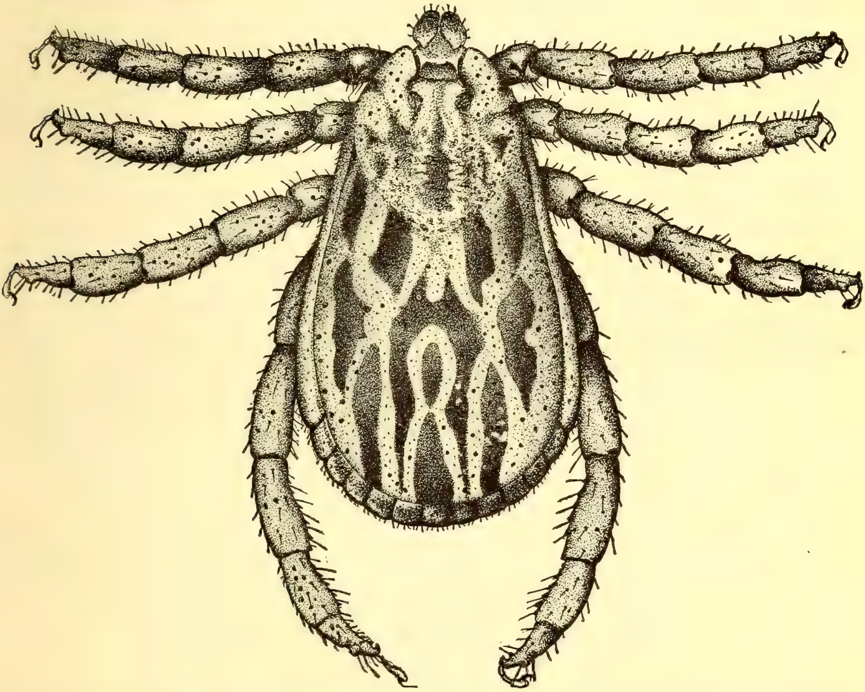

FIG. 178.—Dorsal view, male *Dermacentor variegatus* from the wapiti; Blue Mountains, New Hampshire Notice the pseudo-scutum on anterior portion. Greatly magnified. Original. B. A. I. Coll. 3172.

Replete female.—Body more or less swollen, slightly constricted laterally at the stigmata, may attain 16 mm. long by 10 mm. broad; of a deep brown to slate color; legs almost black (alcohol specimens), brown (live specimens). Scutum, with thin, silvery white metallic rust, with some rose to greenish tinge. Grooves become more effaced as body becomes larger; punctations also nearly disappear; nearly all the hairs are lost. Capitulum, 800 to 900 μ.

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[1] We have been able to find only three rows of denticles on the American specimens of this species. In some cases, however, the teeth on the apophysis of the mandibles assumed a position which gave the appearance of a fourth row. Both Canestrini (1890, p. 520, Tav. XLI, fig. 4d) and Neumann (1897, p. 362) agree that there are four rows anteriorly, then three rows posteriorly.

This species is subject to great variation in appearance, a fact which has resulted in different specimens being described as representing distinct species.

It has been collected from man, cattle, horses, deer, roe deer, sheep, fallow deer, and rhinoceros, and has a very wide geographical distribution. It is recorded in this country for California, Texas, and New Mexico, and also from various countries in Europe and Asia.

The description given above is, with slight modifications, a direct translation from Neumann. Two sendings which have recently reached us—one from horses in Tennessee, the other from cattle in Oklahoma—show exceedingly slight variations from the characters cited by Neumann. We do not, however, feel justified in describing them as distinct from *D. reticulatus*.

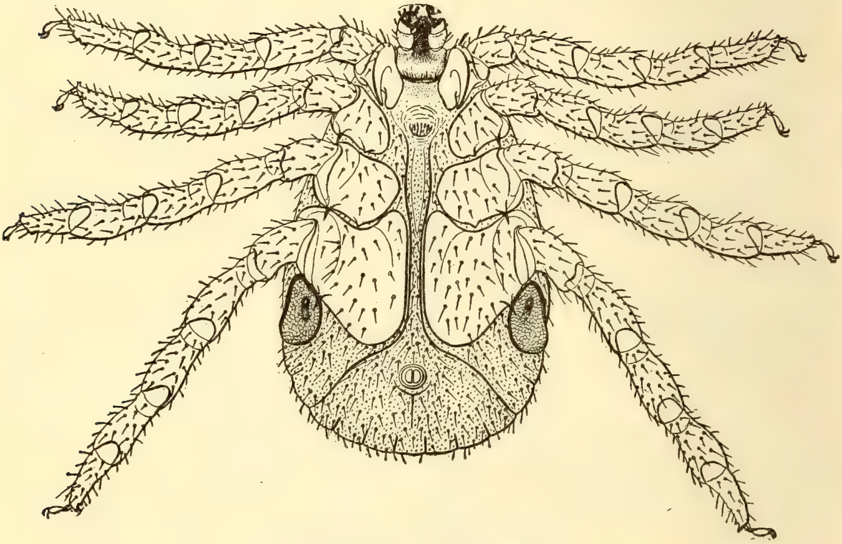

FIG. 179.—Ventral view of same.

THE MOOSE TICK (*Dermacentor variegatus*).[1]

(Figs. 178–185.)

SPECIFIC DIAGNOSIS.—*Dermacentor:* Stigmal plate coarsely punctate.

Male.—Body subtriangular, sides nearly straight, posterior end rounded, 6.5 mm. long, 1.1 mm. broad anteriorly to 4.3 mm. posteriorly. Scutum deep reddish brown, nearly covered with a regularly distributed whitish rust, which indistinctly limits an anterior reddish brown portion (pseudo-scutum), somewhat resembling in form and color the female scutum, and leaving following portions reddish brown; (1) 4 longitudinal dark spots arranged in a semicircle posterior of the pseudo-scutum;

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[1] SYNONYMY AND BIBLIOGRAPHY.

1897: *Dermacentor variegatus* MARX & NEUMANN, 1897, pp. 367–370, 383, figs. 22–24.—WARD, 1900a, p. 201.—STILES & HASSALL, 1901, p. 3.—SALMON & STILES, 1901, pp. 452–454, figs. 178–185.

(2) 1 elongate reniform **dark** spot back of these, near side of shield; (3) 1 more or less distinct forked longitudinal dark band extending from pseudo-scutum to near posterior margin; 1 median, 2 submedian elongate dark spots, posterior; (4) marginal groove, external border, and 5 median postero-marginal shields are also dark. Entire surface finely and sparsely punctate, with microscopic white hairs. Ventral surface as in the female, except differences due to coxæ. Genital pore between coxæ II. Stigmata round to comma-shaped. Capitulum 700 μ long; base same dimension as in female, postero-lateral angle prolonged, prominent; digit of mandibles 185 μ, similar to those of male *D. reticulatus;* hypostome as in *D. reticulatus;* palpi shorter than in female, especially second article. Legs: coxæ increase in size and become more convergent from I to II; pair IV very large; their posterior margin may be about on a line with posterior margin of stigmata, their median margin nearly parallel for some distance; same projections as in female, but postero-median tubercle absent from coxæ IV; other articles of legs similar to *D. reticulatus.*

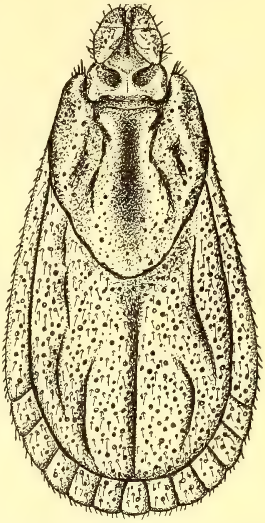
FIG. 180.—Dorsal view, female *Dermacentor variegatus.* B. A. I Coll. 3172.

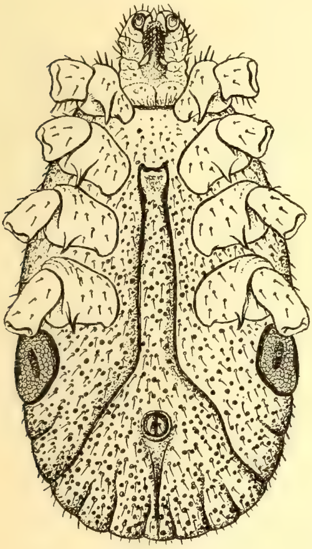
FIG. 181.—Ventral view of same.

Female.—Body depressed, oblong, sides nearly parallel, nearly as broad anteriorly as posteriorly, 5 to 17 mm. long, 2.5 to 10 mm. broad, color reddish brown (alcohol specimens); capitulum and legs not so dark. Scutum elongate, subpentagonal, extending nearly to the middle of the back in young specimens, deeply excavate anteriorly, so as to form two antero-lateral acute points; cervical grooves curved, deep in front, broad and not very distinct in back; punctations fine, numerous; color light brown, with some thin white rust of slightly metallic effect, and leaving exposed a median longitudinal band, the cervical grooves, and a small band along the convexity of the latter, and a brown spot median of the light brownish eyes. Dorsal surface roughened with numerous punctations provided with very short whitish hairs; marginal grooves well marked; 3 longitudinal grooves. Ventral surface covered with fine hairs; genital pore between coxæ II, narrow, oval, surrounded by a broad swelling; genital grooves close to each other in their anterior portion; diverging back of coxæ IV; the genital and ano-marginal grooves similar to those of *D. reticulatus.* Stigmata larger than coxæ IV, whitish or brownish, irregularly oval, with or without dorsal prolongations. Capitulum 1 mm. long, posterior border sinuous, postero-lateral angles slightly or prominently salient; porose areas deep. Mandibular digit 180 μ long, similar to that of

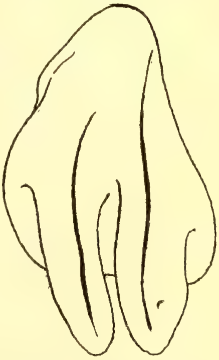
FIG. 188.—Coxa I of *Dermacentor electus;* diagram. Greatly enlarged. Original.

D. reticulatus. Hypostome similar to that of *D. reticulatus*, with three rows of denticles on each half. Palpi slightly longer than hypostome, at least twice as long as broad, not extending laterally of base of capitulum; second article longer than broad, dorsal retrograde projection small; third article slightly broader than long, its apex rounded; second and third articles provided with hairs, especially ventrally. Legs relatively long, all articles with hairs. Coxæ approximated (in young specimens); coxæ I bidentate, the lateral division forming a spine; coxæ II to IV with small acute spine near postero-lateral angle, and a flat tubercle at posteromedian angle; trochanters I with broad dorsal retrograde spine; tarsi with tubercles on ventral border; all legs with terminal spur; pulvillum reaches nearly to recurved portion of claws.

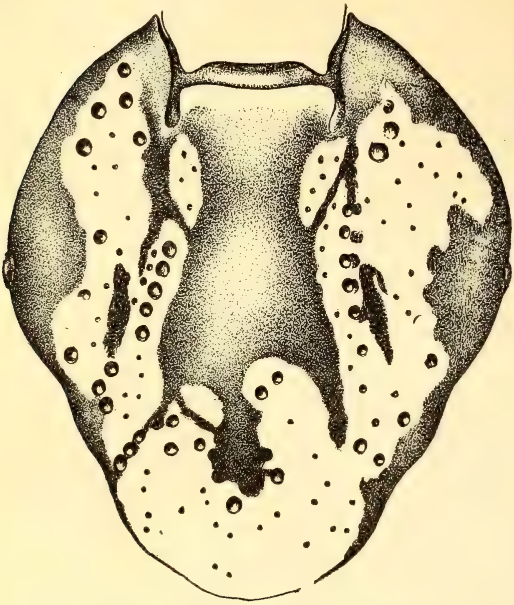

FIG. 189.—Scutum of female of *Dermacentor electus*. Greatly enlarged. Original.

This species is abundant on the wapiti (*Cariacus canadensis*); it has been collected in Washington (State), Nebraska, Nevada, and New York (Adirondacks). Complaints have been made to this Bureau that it is exceedingly common on wapiti in the reserve of the Blue Mountain Forest Association, and according to reports from the gamekeepers it kills numbers of the deer. Whether the wapiti really die from the direct effects of the bite of these ticks (as seems improbable), from its indirect effects by the transmission of some disease, from liver fluke disease caused by *Fasciola magna*, or from some other cause has not, in our opinion, been established.

D. variegatus is not yet recorded for steers, but there can be little doubt regarding the likelihood of its attacking cattle.

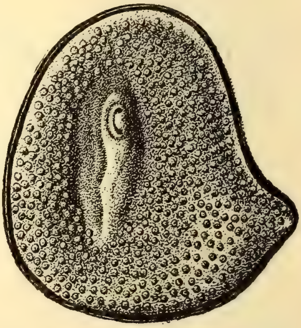

FIG. 190.—Stigmen of same. Greatly enlarged. Original.

There is a question in our minds whether *D. variegatus* is really specifically distinct from *D. reticulatus*. Neumann admits that good anatomical differences are lacking, and that it may perhaps be simply a variety of *D. reticulatus*.

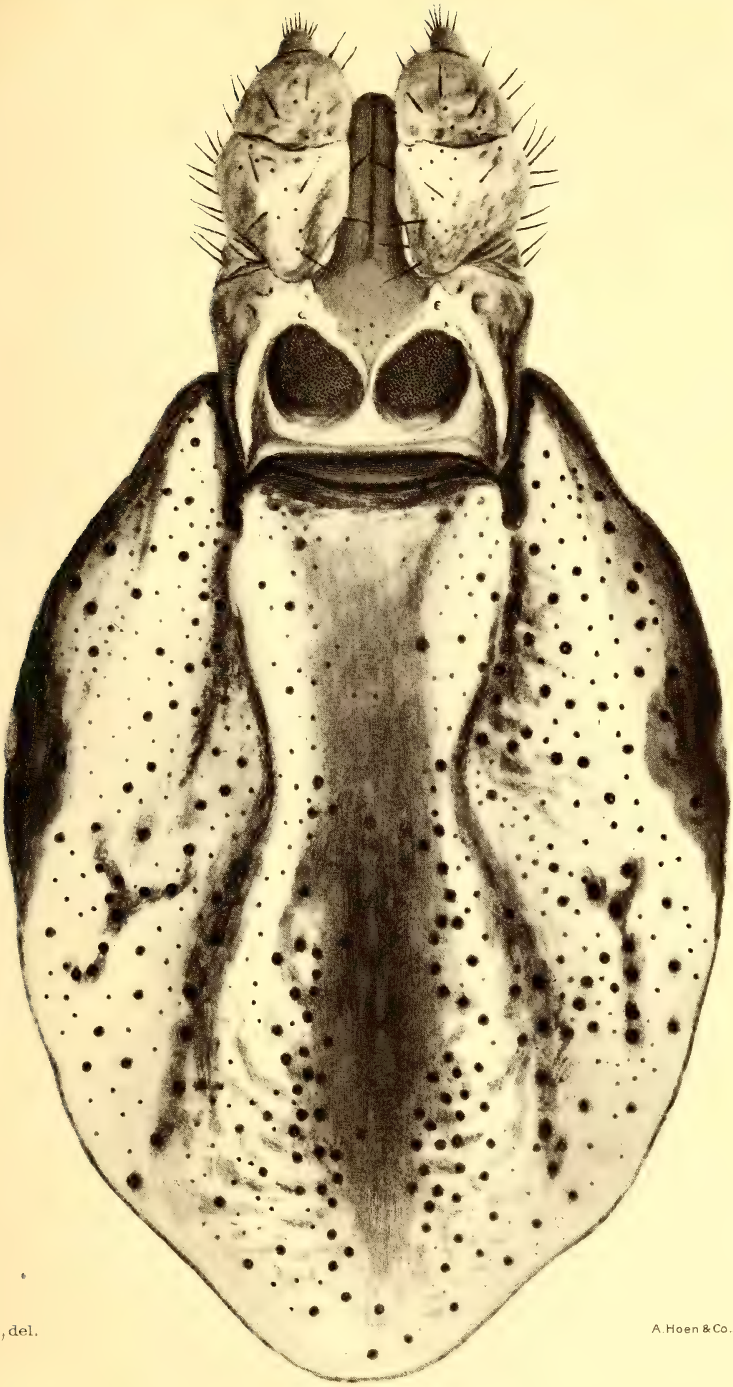

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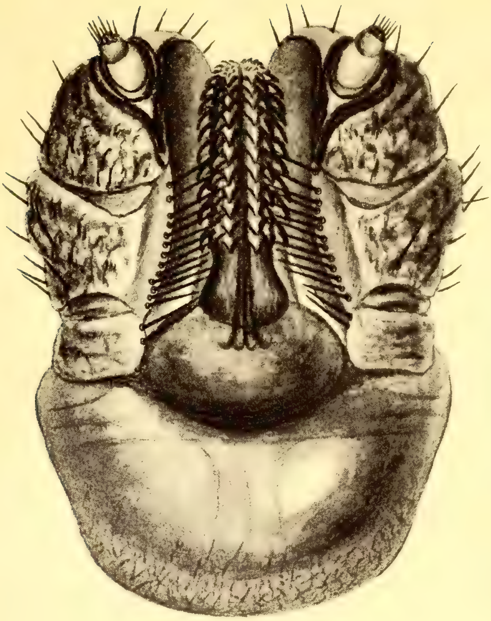
FIG. 182. DORSAL VIEW OF SCUTUM AND CAPITULUM OF DERMACENTOR VARIEGATUS.



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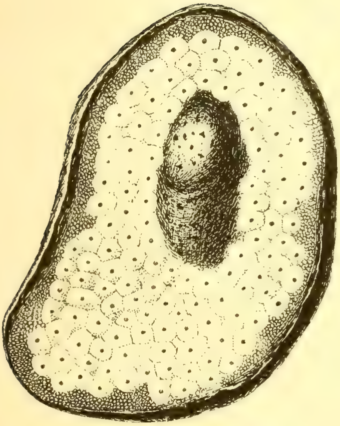

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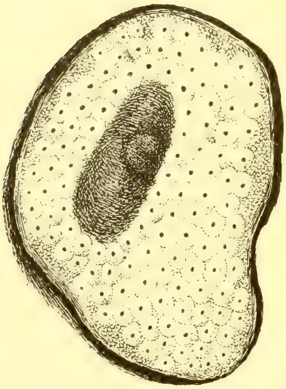

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FIG. 183. VENTRAL VIEW OF CAPITULUM OF DERMACENTOR VARIEGATUS.

FIG. 184. STIGMEN OF MALE. GREATLY ENLARGED TO SHOW COARSE PUNCTATION. ORIGINAL.

FIG. 185. STIGMEN OF FEMALE. GREATLY ENLARGED. ORIGINAL.

THE AMERICAN DOG TICK (*Dermacentor electus*).[1]

(Figures 186–214.)

SPECIFIC DIAGNOSIS—*Dermacentor:* Differs from *D. reticulatus* in following characters: Stigmal plate finely punctate.

Male.—Scutum with milky white rust, reproducing anteriorly the shield of the female (pseudo-scutum); the rust forms on each side a long band with sinuous borders extending from the anterior point of the shield to the two extreme festoons of the posterior border. These bands leave laterally two red brown spots (separated by a narrow transverse white band) and the marginal border where there are two white spots opposite the dark spots. Between their divergent posterior extremities the two longitudinal bands are united by two other parallel longitudinal bands occupying a third of the length of the shield, and only the borders and posterior extremities of which are white. All the festoons are brown except occasionally the extremes of each side; punctations larger and deeper. Capitulum: digit of the mandibles 130 to 140 μ long, thicker, the internal apophysis almost terminal; palpi shorter and more convex laterally than in the female; dorsal retrograde projection of second article not very prominent. Stigmal plates comma-shaped to elongate oval. Legs: coxæ IV do not extend caudad of the middle of the peritreme; otherwise like the male of *D. reticulatus.*

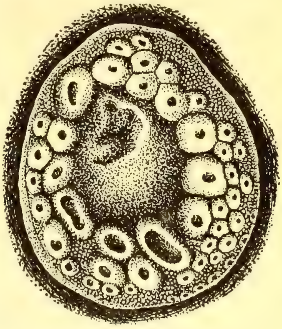

FIG. 215.—Stigmen of female *Dermacentor nitens*, from ear of pony. Porto Rico. Greatly enlarged. Original. B. A. I. Coll. 3102.

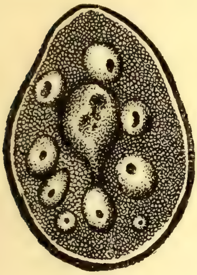

FIG. 216.—Stigmen of male *Dermacentor nitens*, from ear of pony. Porto Rico. Greatly enlarged. Original. B. A. I. Coll. 3102.

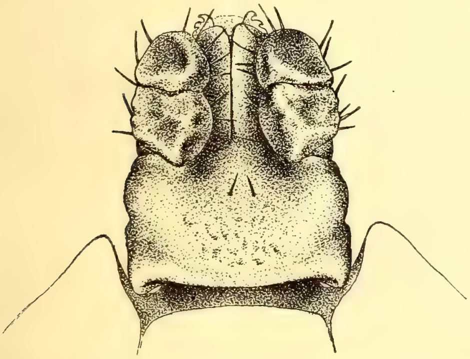

FIG. 217.—Dorsal view, capitulum of male *D. nitens.* B. A. I. Coll. 3102.

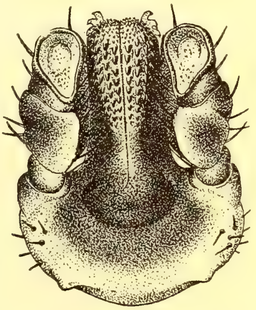

FIG. 218.—Ventral view of same.

Female, straighter. Scutum straighter, more elongate, with a scarcely distinguishable sinus on posterior third of lateral border; anterior emargination limited by two acute projecting angles; cervical grooves deep anteriorly, superficial in the posterior two-thirds; yellowish white rust

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[1] SYNONYMY AND BIBLIOGRAPHY.

1844: *Dermacentor electus* KOCH, 1844, p. 235; type locality, Pennsylvania.—IDEM, 1847, p. 109, pl. XXII, figs. 83, 84.—SALMON & STILES, 1901, pp. 455, 456, less abundant, leaving a free space between the two grooves, except in the posterior part; eyes near middle of the lateral border. Dorsal surface with fewer hairs, which are scarcely visible. Capitulum straighter. Mandibles 1.5 mm. long; digit 165 μ. Hypostome with three rows of 12 to 13 short broad denticles. Palpi a little longer, straighter, slightly convex laterally; third article less triangular on its dorsal surface; hairs less numerous on the internal ventral surface of the first to third articles; a few hairs on the internal dorsal border. Stigmal plates comma-shaped to elongate oval. Coxæ relatively a little more elongated; articles of legs a little narrower; tarsi I without spur; pulvillum extends beyond the middle of the hooks.

Replete female attains 15 mm. in length by 9 mm. in breadth.

This tick has been taken from man, cattle, dogs, horses, panther, rabbits, and elan. It is abundant and widely distributed, especially east of the Rocky Mountains.

The above description, which is almost a verbatim translation of Neumann's work, was apparently based upon a number of preserved specimens. Our experience with live and preserved specimens is that the coloration and spots are exceedingly variable, but that the punctation of the stigmal plates is a reliable and easily recognizable character by which *D. electus* may be readily distinguished from both *D. reticulatus* and *D. variegatus*. It may also be remarked that *D. electus* is usually smaller than *D. reticulatus* and *D. variegatus*.

It has been very generally supposed that this was the form to which Linnæus originally gave the name *Acarus americanus*, and authors have on this account referred to it under the name *Dermacentor americanus*. As will be seen from discussion on page 477, we believe that a confusion has arisen between this and *Amblyomma americanum*.

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figs. 186–214. [See also Neumann, 1897, p. 366, as syn. of *Dermacentor americanus*.]

1889: ? "*Ixodes bovis* Riley" of Cook, 1889, pp. 229, 230, figs. 81–83.

1892: "*Dermacentor americanus*" (Linnæus) of Curtice, 1892b, pp. 226, 231, 234.—Idem, 1892c, p. 237.—Railliet, 1893, p. 714, in part.—Osborn, 1896, p. 261, fig. 153.—Marx, 1892, p. 236.—Lugger, 1896, pp. 120–122, figs. 61, 62.—Neumann, 1897, pp. 365–367, 383.—Niles, 1898, pp. 28, 30, pl. iii, figs. 1–5.—Dalrymple, Morgan & Dodson, 1898, p. 241.—Morgan, 1899, pp. 128, 129, 133, 134, 135, 141, pls. v–vi.—Ward, 1900a, pp. 200–201, fig. 4.—Idem, 1900b, pp. 436–437, fig. 259.

1892: "*Dermacentor americanum* Linn." of Curtice, 1892b, p. 226.

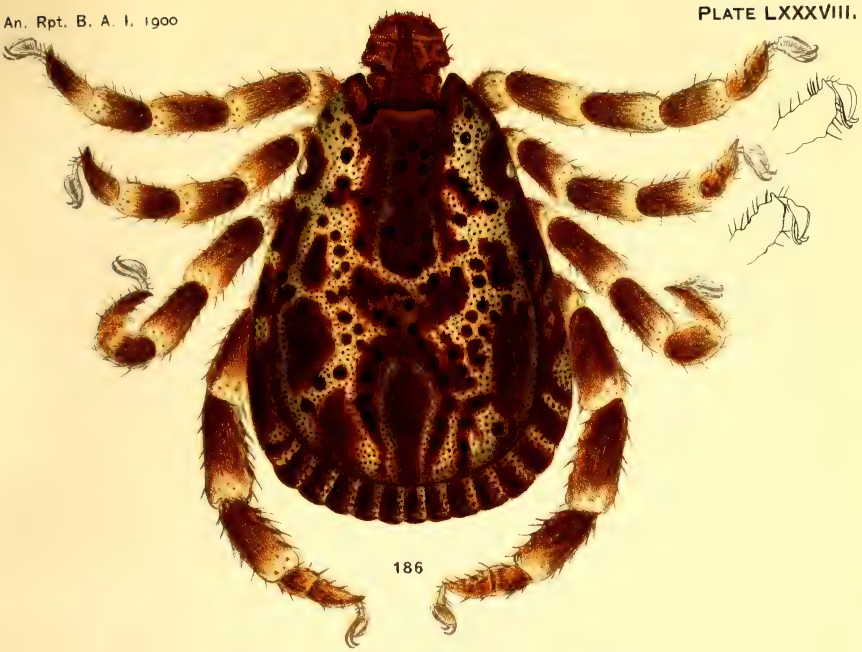
1894: "*Dermacenter americanus*" (Linnæus) of Francis, 1894, p. 451.

1869: *Ixodes naponensis* Packard, 1860, p. 65. [See also Neumann, 1897, p. 366, and Ward, 1900b, p. 436, as syn. of *Dermacentor americanus*.]

1869: *Ixodes albipictus* Packard, 1869, p. 65.—Verrill, 1870, p. 118, figs. 42–44.—Cobbold, 1879, p. 350.—Holland, 1898, p. 96. [See also Neumann, 1897, p. 366, as syn. of *Dermacentor americanus*.—Ward, 1900b, p. 436.—Moose tick <American Naturalist, 1868, p. 559.]

1870: "*Ixodes albiptctus* Packard" of Verrill, 1870, p. 117 (misprint for *I. albipictus*).

1899: "*Dermocenter americanus* Linn." of Lewis, 1899, p. 3.



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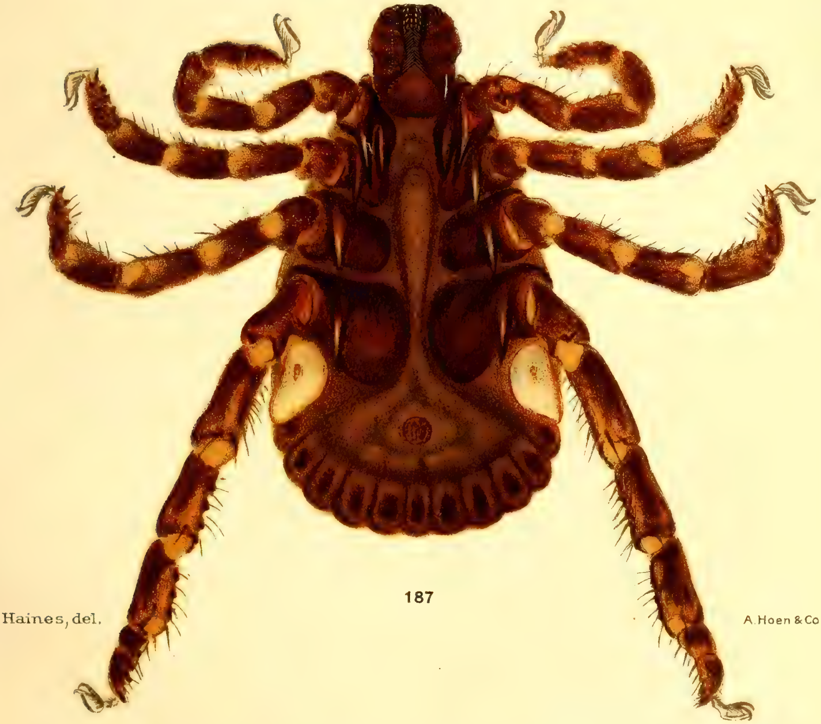


187

Haines, del.

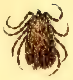
A. Hoen & Co., Lith

FIG. 186. DORSAL VIEW OF MALE DERMACENTOR ELECTUS FROM DOG; MARYLAND. GREATLY ENLARGED. ORIGINAL FROM LIFE. B. A. I., 3150.

FIG. 187. VENTRAL VIEW OF SAME.

PLATE LXXXIX.

191



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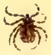

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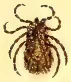

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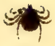

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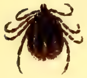

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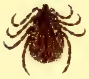

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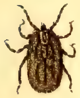

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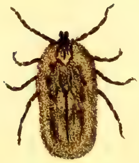

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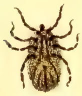

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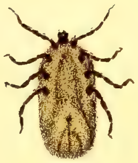

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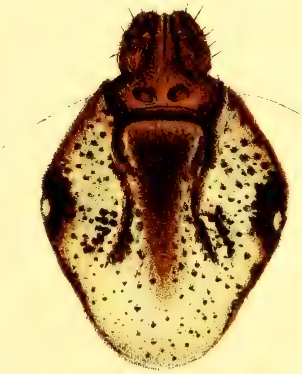


203

A Hoen & Co., Lithocaustic

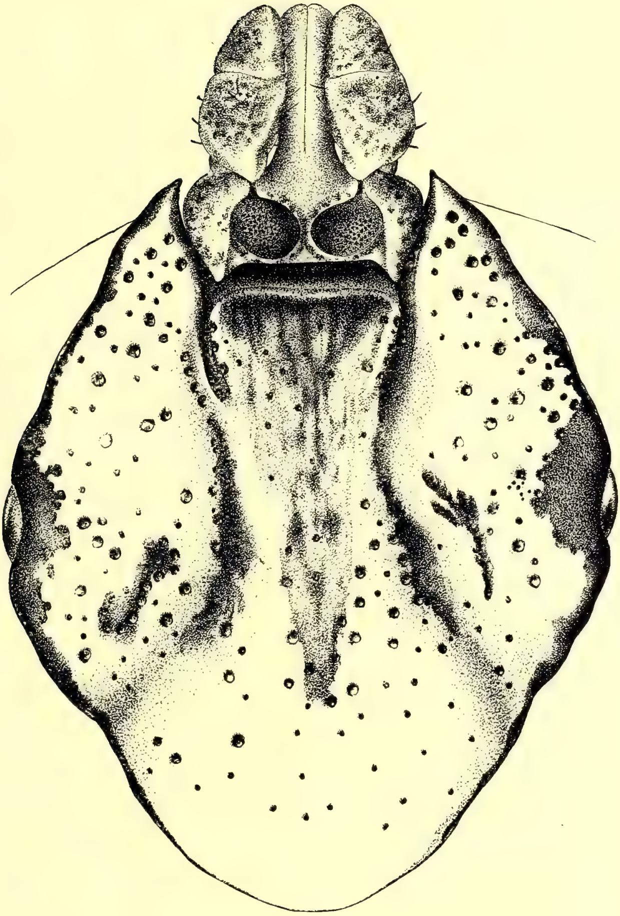
Figs. 191 (male), 195 (young female), 199 (female). Dorsal view of Dermacentor electus from cattle; Grand Island, Nebr. Natural size. Original from life.

Figs. 192, 196, 200. The same. X2.

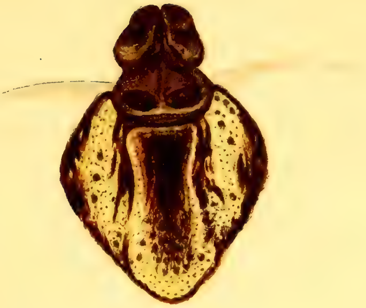
Figs. 193, 197, 201. Ventral view of same. Natural size.

Figs. 194, 198, 202. The same. X2.

Fig. 203. Scutum and capitulum of female. Enlarged. Original from life.



Dermacentor electus. Greatly enlarged.



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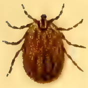

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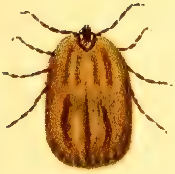

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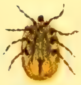

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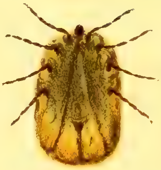

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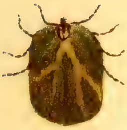

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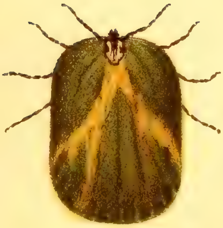

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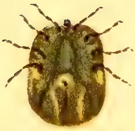

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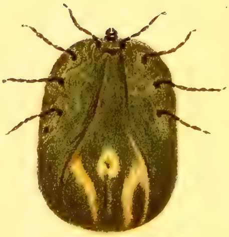


212

Haines, del.

A. Hoen & Co. Lithocaustic.

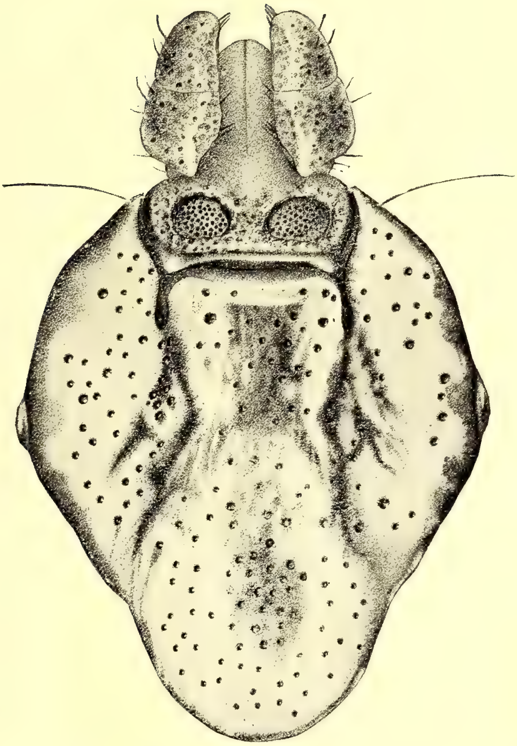
Figs. 205, 206. Dorsal views of female Dermacentor electus from cattle; St. Joseph, Mo. Natural size. Original from nature. B. A. I., 3011.

Figs. 207, 208. The same. X2

Figs. 209, 210. Ventral view of same.

Figs. 211, 212. The same. X2.

Fig. 213. Scutum of female. Greatly enlarged. Original.



DERMACENTOR ELECTUS. GREATLY ENLARGED.

Genus Hæmaphysalis[1] Koch, 1844.

Generic diagnosis.[2]—*Ixodinæ*: Eyes absent. Base of capitulum rectangular, twice as broad as long. Palpi conical, second article with strong conical latero-basal projection. Stigmal plate circular or in short comma. Anal shields of male absent. Coxæ I not bifide; coxæ IV of normal dimensions in male.
Teguments of uniform color, brownish.

Type species.—*Hæmaphysalis concinna.*

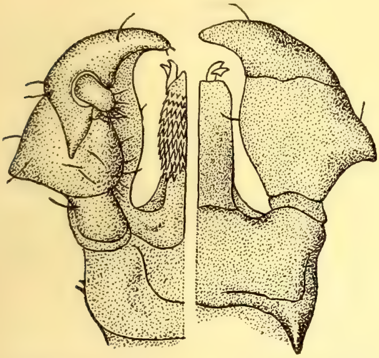


Fig. 219.—Capitulum of male *Hæmaphysalis concinna:* ventral and dorsal view of right half. X 65. After Neumann, 1897, p. 339, fig. 4.

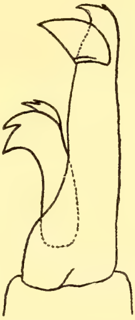


Fig. 220.—Digit of left maxilla of same. X 230. After Neumann, 1897, p. 340, fig. 5.

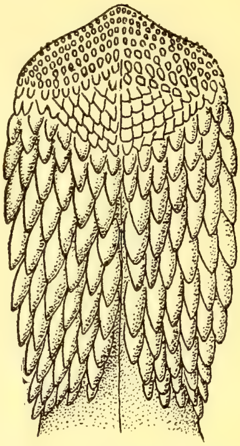


Fig. 221.—Hypostome of same. X 210. After Neumann, 1897, p. 340, fig. 6.

Neumann mentions two North American species, *H. leporis-palustris* and *H. concinna*, neither of which appears to have been reported for cattle.

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[1] Synonymy and Bibliography.

1844: *Hæmaphysalis* Koch, 1844, p. 237.—Idem, 1847, p. 239.—Fürstenberg, 1861, p. 208.—Murray, 1877, p. 199.—Canestrini & Fanzago, 1877, pp. 178, 186, 188–190.—Cambridge, 1889, p. 406.—Canestrini, 1890, pp. 476, 481, 483, 484, 485, 486, 487, 488, 490, 491, 493, 523–526.—Idem, 1892, p. 581.—Marx, 1892, pp. 233, 236.—Trouessart, 1892, p. 47.—Railliet, 1893, pp. 714, 715.—Neumann, 1897, pp. 325, 326–359.—Morgan, 1899, p. 139.—Ward, 1900a, p. 200.—Salmon & Stiles, 1901, pp. 456–458. [See also Curtice, 1891a, p. 317, and 1891b, p. 685.]

1844: *Rhipistoma* Koch, 1844, p. 239.—Idem, 1847, p. 27.—Fürstenberg, 1861, p. 208.—Canestrini, 1890, pp. 483, 486.—Marx, 1892, pp. 233, 236; type, *Leachii.* [See also Neumann, 1897, p. 326, as syn. of *Hæmaphysalis.*]

1888: *Gonixodes* Dugès, 1888, pp. 129–133; type, *rostralis* = *H. leporis-palustris.* [See also Canestrini, 1890, p. 485.—Marx, 1892, p. 236.—Neumann, 1897, p. 326.]

1897: *Opisthodon* Canestrini, 1897, p. 468; type, *cuscobius.* [See also Neumann, 1897, p. 326, as syn. of *Hæmaphysalis.*]

1899: "*Gonixides* Dugès" of Morgan, 1899, p. 139.

[2] Neumann (1897) suppresses *Opisthodon* as synonym of *Hæmaphysalis.* While not acquainted with any species of *Opisthodon*, the characters attributed to this genus would indicate to our minds that it is entitled to subgeneric rank, possibly to generic rank.

KEY TO THE SPECIES OF THE GENUS HÆMAPHYSALIS.[1]

[For forms reported for the United States, follow Roman type.]

Females 1
Males 15

A.—Female.

1. Second palpal article angular or rounded laterally 2
   Second palpal article acute, spinescent (laterally) 12
2. Palpi as broad as long, or broader than long 3
   Palpi longer than broad .... *H. leporis-palustris.*
3. Scutum punctate 4
   Scutum not punctate .... *H. rhinolophi.*
4. Coxæ I provided with a spine 5
   Coxæ I without a spine (Tunis) .... *H. erinacei.*
5. *Tarsi IV less than four times as long as broad* 6
   Tarsi IV at least four times as long as broad 10
6. *Scutum as broad as long or nearly so, and with sides convex* 7
   Scutum much longer than broad; sides nearly straight (Brazil) .... *H. sanguinolenta.*
7. *Second palpal article rounded laterally* 8
   Second palpal article angular laterally 9
8. *Ventral aspect of uniform color* (Europe, Asia, Africa) .... *H. punctata.*
   Ventral aspect whitish around vulva and anus (Brazil) .... *H. cinnaberina.*
9. *Third papal article with a ventral spine* (Asia) .... *H. flava.*
   Third palpal article without ventral spine (New Guinea, Australia) .... *H. papuana.*
10. Third palpal article without dorsal horn 11
    Third palpal article with dorsal retrograde horn (India) .... *H. bispinosa.*
11. Tarsi I five times as long as broad .... *H. concinna.*
    Tarsi I three times as long as broad (Asia) .... *H. hirudo.*
12. *A simple tuberosity on coxæ IV* 13
    A sharp spine on every coxa (Madagascar) .... *H. elongata.*
13. *Scutum much longer than broad* (Africa) .... *H. Leachi.*
    Scutum scarcely or not longer than broad 14
14. *Second palpal article with retrograde prolongation* (Asia) .... *H. spinigera.*
    Second palpal article without retrograde prolongation (Singapore, Borneo, Sumatra) .... *H. cornigera.*

B.—Male.

15. Third palpal articles not forming pincers together 16
    Third palpal articles prolonged toward median line and meeting to form pincers .... *H. concinna.*
16. Coxæ I provided with a spine 17
    Coxæ I without spine .... *H. erinacei.*
17. External angle of second palpal article without dorsal retrograde prolongation 18
    External angle of second palpal article with dorsal retrograde prolongation 24
18. External angle of second palpal article without ventral retrograde prolongation 19
    External angle of second palpal article with ventral retrograde prolongation (Asia) .... *H. spinigera.*
19. Spine of coxæ I feeble or nil 20
    Spine of coxæ I strong (Singapore, Borneo, Sumatra) .... *H. cornigera.*

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[1] This key does not contain the species *Birmaniæ, histricis, cuscobia, Canestrinii, asiatica,* and *Gestroi.*

20. *External angle of second palpal article rounded* (Europe, Asia, Africra). *H. punctata.*
External angle of second palpal article angular 21
21. *Each palpus nearly as broad as long* 22
Each palpus much longer than broad .... *H. leporis-palustris.*
22. *Third palpal article with ventral retrograde projection* 23
Third palpal article without ventral retrograde projection (New Guinea, Australia) .... *H. papuana.*
23. *Cervical furrows very deep; second and third palpal articles not separated by a reentrant angle* (Asia) .... *H. flava.*
Cervical furrows rudimentary; second and third palpal articles separated laterally by a reentrant angle (Madagascar) .... *H. simplex.*
24. *Dorsal surface of palpi, longer than broad* (Madagascar) .... *H. elongata.*
Dorsal surface of palpi as broad as long or broader (Africa) .... *H. Leachi.*

C.—Based upon the denticles of the hypostome.

Two rows on each half; nymph; American .... *H. leporis-palustris.*
Two rows on each half; nymph and larva; not American .... *H. punctata.*
Three rows: *H. leporis-palustris* ♂ ♀; *H. simplex*, nymph; *H. elongata* ♂ ♀.
Four rows: *H. flava* ♂ ♀; *H. Birmaniæ* ♀; *H. papuana* ♂ ♀; *H. bispinosa* ♀; *H. simplex* ♂; *H. Leachi* ♀; *H. cornigera* ♀; *H. spinigera* ♀; *H. Canestrinii* ♂.
Five rows: *H. punctata* ♂ ♀; *H. rhinolophi* ♀; *H. flava* ♂; *H. Birmaniæ* ♂; *H. concinna* ♀; *H. hystricis* ♂ ♀; *H. Leachi* ♂ ♀; *H. cornigera* ♂; *H. cuscobia* ♂; *H. spinigera* ♂.
Six rows: *H. flava* ♂; *H. concinna* ♂; *H. asiatica* ♂.
Seven rows: *H. Gestroi* ♀.

Subfamily Ixodinæ[1] SALMON & STILES, 1901.

SUBFAMILY DIAGNOSIS.—*Ixodidæ:* Palpi long, usually about the same length as the hypostome.

TYPE GENUS.—*Ixodes.*

This subfamily includes the genera *Ixodes*, *Eschatocephalus*, *Aponomma*, *Amblyomma*, and *Hyalomma*. (For analytical key, see p. 385.)

GENUS IXODES[2] Latreille, 1796.

GENERIC DIAGNOSIS.—*Ixodinæ:* Eyes absent. Palpi long. Anal groove open or closed caudad, but tangent to the anus by its anterior concavity. Tarsi without ter-

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[1] SYNONYMY AND BIBLIOGRAPHY.

1844: Fam. *Ixodiden* KOCH, 1844, pp. 220–234.—IDEM, 1847, pp. 13–23.
1861: Fam. *Ixodides* FÜRSTENBERG, 1861, p. 208.
1890: *Cultripalpi* CANESTRINI, 1890, p. 491. [See also NEUMANN, 1899, p. 107.]
1892: Fam. *Ixodidæ* MARX, 1892, pp. 233, 234, 235.
1892: *Hæmalastoridæ* MARX, 1892, pp. 234, 235.
1892: *Eschatocephalidæ* MARX, 1892, pp. 233, 234.
1899: Tribe *Ixodæ* NEUMANN, 1899, pp. 107–294.
1901: Subfam. *Ixodinæ* SALMON & STILES, 1901, pp. 458–478.

[2] SYNONYMY AND BIBLIOGRAPHY.

1796: *Ixodes* LATREILLE, 1796, p. 179; type, *Acarus ricinus.*—IDEM, 1804, pp. 46, 51–53.—IDEM, 1806, pp. 155–159.—IDEM, 1829, pp. 287, 288.—FABRICIUS, 1805, minal spurs. *Male* with ventral shields; prægenital shield between genital pore and capitulum; 2 lateral epimeral shields, more or less surrounding the coxæ and stigmata; a genito-anal shield of elongate pentagonal form between genital pore and anus; an anal shield, triangular, ogival, or circular, caudad of preceding, the anterior apex encircling the anus, the base formed by the posterior margin of the body; two adanal, quadrangular shields parallel to the anal shield. Scutum leaving an uncovered lateral and posterior margin; postero-marginal festoons absent. Stigmata oval.

Female.—With three dorsal longitudinal posterior grooves on the ventral surface; two long genital grooves extending from the vulva and diverging caudad, and two anal grooves united in front of the anus, parallel or divergent in back, rarely convergent. Stigmata circular.

Type species.—*Ixodes ricinus* (Linnæus).

This genus has been the collective group for the ticks, naturalists who were unfamiliar with the family placing in *Ixodes* any species which they believed to be new. Many of the forms are to-day unrecognizable, as they have been described on insufficient characters.

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pp. 351–356.—Chabrier (1807).—Leach, 1815, pp. 397–399.—Heyden, 1826, p. 610.—Risso, 1826, p. 182.—Burmeister, 1837, p. 579.—Koch, 1844, p. 231.—Idem, 1847, pp. 20–23.—Gervais, 1844, p. 234–251.—Idem, 1847, p. 351, 352.—Gervais & van Beneden, 1859, pp. 460, 461.—Grube, 1859, p. 455.—Fürstenberg, 1861, p. 208.—Moquin-Tandon, 1861, p. 304.—Gerstaecker, 1863, p. 344.—Lucas, 1866, p. lvii.—Verrill, 1870, pp. 116–118.—Murray, 1877, pp. 187, 190–195.—Canestrini & Fanzago, 1877, pp. 178, 179–186, 187.—Mégnin, 1880a, pp. 121–132, 320–322.—Idem, 1880b, p. 603.—Idem, 1895, p. 354.—Haller, 1882, pp. 309–311.—Berlese, 1885, p. 131.—Braun, 1883, pp. 211, 212.—Idem, 1895, p. 257.—Raymondaud (1885).—Ludwig, 1886, p. 612.—Railliet, 1886, pp. 496–499.—Idem, 1893, pp. 706–710.—Neumann, 1888, p. 89.—Idem, 1892a, pp. 92, 93–100.—Idem, 1892b, pp. 96–98.—Idem, 1897, p. 325.—Idem, 1899, pp. 108–166, 168.—Canestrini, 1890, pp. 476, 479, 482, 483, 484, 485, 486, 487, 488, 489, 490, 491, 492, 494, 530.—Idem, 1892, p. 581.—Batelli, 1891, p. 78, 79, 80.—Efisio, 1892, p. 256.—Trouessart, 1892, p. 47.—Lewis, 1892, p. 449.—Marx, 1892, pp. 232, 233, 235.—Oudemans, 1896, p. 191.—Osborn, 1896, p. 262.—Blanchard, 1890, pp. 323–329.—Morgan, 1899, p. 138.—Ward, 1900a, pp. 196, 203–204.—Idem, 1900b, p. 436.—Salmon & Stiles, 1901, pp. 459–468. [See also Kolenati, 1857, p. 24.—Conil, 1877, pp. 25, 26, 27, 28, 29.—Idem, 1878, pp. 99, 100, 101.—Trouessart, 1891, pp. 290, 291, 292, 293, 294, 295, 297, 300.—Idem, 1892, pp. 20, 33.—Neumann, 1897, p. 360, sub *Dermacentor.*—Idem, 1897, p. 384, sub *Rhipicephalus.*—Idem, 1899, p. 283, sub *Hyalomma.*]

1804: *Cynorhæstes* Hermann (1804, p. 66).—Risso, 1826, p. 183.—Treviranus, 1831, p. 188. [See also Heyden, 1826, p. 610.—Gervais, 1844, pp. 234–236.—Neumann, 1888, p. 89.—Idem, 1892a, p. 93.—Idem, 1892b, p. 96.—Idem, 1899, p. 108, sub *Ixodes.*—Idem, 1899, p. 283, sub *Hyalomma.*—Canestrini, 1890, p. 482.—Railliet, 1893, p. 706, sub *Ixodes.*]

1805: "*Cynorrhæstes* Herman" of Fabricius, 1805, pp. 351, 352, 353, and of Dugès, 1834c, p. 33.

1822: *Crotonus* Duméril, 1822, p. 56.—Idem, 1829, pp. 401, 402; type, *ricinus.* [See also Neumann, 1899, p. 108, as syn. of *Ixodes.*]

1829: "*Cynoræsthes* Hermann" of Latreille, 1829, p. 287.

1880: "*Cynochæstes* Hermann" of Mégnin, 1880, p. 121.

1891: "*Cynorhœstes* Hermann" of Trouessart, 1891, p. 290.

Several species occur in America, and two of them, *Ixodes ricinus* and *I. hexagonus*, occur on American cattle. Neumann gives the following key to the species known to him:

KEY TO THE SPECIES OF THE GENUS IXODES.

[For North American forms, follow Roman type.]

Males 1
Females 9
Nymphs 35

A.—Male.

1. Anal shield with divergent or parallel sides 2
Anal shield with convergent sides 7
2. Scutum covering the greater part of the back 3
Scutum scarcely covering half of the width of the back (South America) . *I. loricatus.*
3. Posterior margin of scutum not fimbriate 4
Posterior margin of the scutum divided into 5 short broad segments provided with long hairs (Bering Island) .... *I. fimbriatus.*
4. Coxæ I with strong median spine 5
Coxæ I: Median and lateral spines short and equal (Egypt) .... *I. coxæfurcatus.*
5. Tarsi without dorsal protuberance 6
Tarsi with dorsal protuberance near the tip .... *I. hexagonus*, p. 467
6. Scutum pubescent .... *I. ricinus*, p. 462
Scutum glabrous (Japan, Amoor) .... *I. ovatus.*
7. *Anal shield open caudad* 8
Anal shield closed caudad (Congo) .... *I. rasus.*
8. *Anal shield horseshoe-shaped* (Africa) .... *I. pilosus.*
Anal shield nearly closed caudad (Australia, India) .... *I. holocyclus.*

B.—Female

9. Anal grooves divergent or parallel 10
Anal grooves convergent 34
10. First palpal article short, not forming an anteriorly directed horn 11
First palpal article forming a strong anteriorly directed horn (South America) .... *I. thoracicus.*
11. Scutum longer than broad 12
Scutum as broad as long, or broader than long 30
12. Sides of scutum rounded 13
Sides of scutum straight, angular, or sinuous 25
13. Lateral grooves of scutum more or less apparent 14
Lateral grooves of scutum absent 21
14. Coxæ I with one spine or with two unequal spines 15
Coxæ I with two equal spines (South America) .... *I. loricatus.*
15. Coxæ I with strong median spine 16
Coxæ I not prolonged in a strong median spine 17
16. Punctations of scutum equal 18
Punctations of scutum unequal, the larger near the margin .... *I. diversifossus.*
17. *Coxæ I with small spine at postero-lateral angle* (South America) .... *I. frontalis var.*
Coxæ I without spine at postero-lateral angle (Congo) .... *I. rasus.*
18. Porose areas broader than long and close together .... *I. ricinus*, p. 462
Porose areas as long as broad, or longer, distant 19
19. *Lateral grooves of scutum slightly apparent; punctations fine* (Japan, Amoor) . *I. ovatus.*
Lateral grooves well marked 20

20. Tarsi with dorsal protuberance (U. S. A.?) .... *I. dentatus.*
Tarsi without dorsal protuberance (Ecuador) .... *I. fossulatus.*
21. *Scutum with unequal punctations, the largest near posterior border* (Costa Rican Felis pardalis) .... *I. affinis.*
Scutum with equal punctations 22
22. *Punctations on shield very fine, close together* 23
Punctations large, distant 24
23. *Body provided with granulations* (Madeira Islands) .... *I. obscurus.*
Body not provided with granulations (New Zealand) .... *I. præcoxalis.*
24. Coxæ I with two subequal spines .... *I. bifurcatus.*
Coxæ I with one long spine (Sumatra) .... *I. spinicoxalis.*
25. Coxæ I provided with spines or tuberosities 26
Coxæ I smooth (British Columbia, Alaska, Cape Horn) .... *I. putus.*
26. *Coxæ I with two small posterior tuberosities* (New Zealand) .... *I. eudyptidis.*
Coxæ I spinose 27
27. Coxæ I unicuspid 28
Coxæ I bicuspid 29
28. Spine on coxæ I long, at postero-median angle .... *I. hexagonus*, p. 467
Spine on coxæ I short, at postero-lateral angle (New Zealand) .... *I. intermedius.*
29. Scutum without lateral grooves. Porose areas rounded .... *I. frontalis.*
Scutum with lateral grooves. Porose areas triangular .... *I. angustus.*
30. *Scutum considerably broader than long* (Tasmania, Mariana Is.) .. *I. ornithorhynchi.*
Scutum as broad as long or scarcely broader than long 31
31. *Coxæ I unarmed* (Tasmania) .... *I. Tasmani.*
Coxæ I armed 32
32. *Coxæ I unicuspid* 33
Coxæ I bicuspid (Sikhim? Sikkim) .... *I. lævis.*
33. *Coxæ I with short spine* (Africa) .... *I. luteus.*
Coxæ I with long spine (Brazil) .... *I. spinosus.*
34. *Anal grooves distant posteriorly* (Africa) .... *I. pilosus.*
Anal grooves reunited in a point posteriorly (Australia, India) .... *I. holocyclus.*

C.—Nymph.

35. Scutum longer than broad 36
Scutum as broad as long or broader 41
36. Anal grooves separated posteriorly 37
Anal grooves reunited in a point posteriorly (Australia, India) .... *I. holocyclus.*
37. Tarsi without protuberance near the extremity 38
Tarsi with protuberance near the extremity .... *I. hexagonus*, p. 467
38. Scutum with lateral grooves 39
Scutum without lateral grooves (British Columbia, Alaska, Cape Horn) .. *I. putus.*
39. Scutum short oval 40
Scutum elongate oval, sides almost straight (South America) .... *I. loricatus.*
40. Hypostome with three rows of denticles on each half .... *I. ricinus*, p. 462
Hypostome with two rows of denticles on each half (Brazil) .... *I. imperfectus.*
41. *Scutum rounded* 42
Scutum cordiform, considerably broader than long (Tasmania, Mariana Is.) *I. ornithorhynchi.*
42. *Coxæ I provided with a long spine* (Brazil) .... *I. spinosus.*
Coxæ I with simple tuberosity (New Grenada) .... *I. juvenis.*

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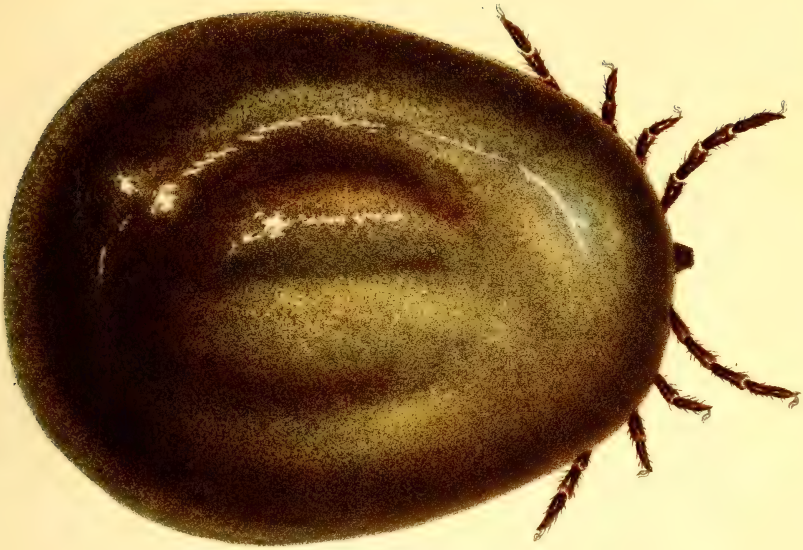

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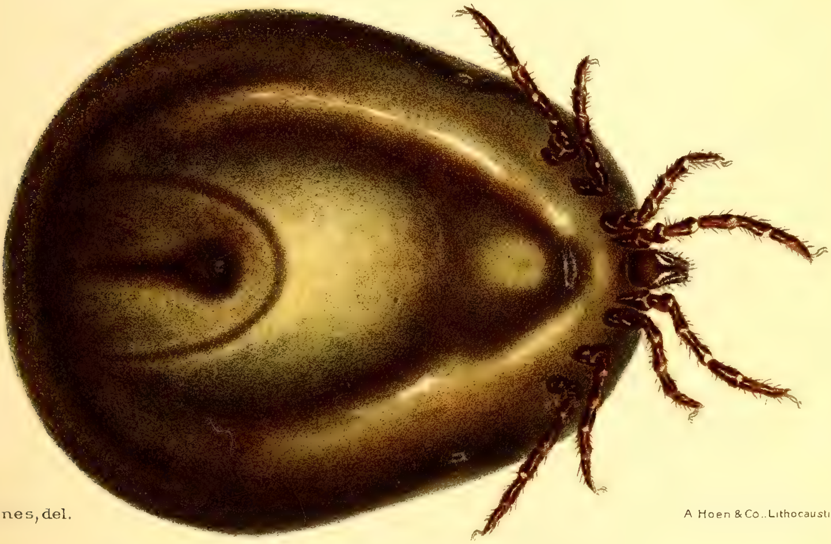

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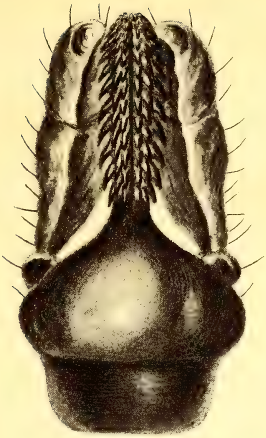
FIG. 223. DORSAL VIEW OF IXODES RICINUS. GREATLY ENLARGED. ORIGINAL. B. A. I., 3141, FROM CATTLE; RICHMOND, VA.

FIG. 224. VENTRAL VIEW OF SAME.



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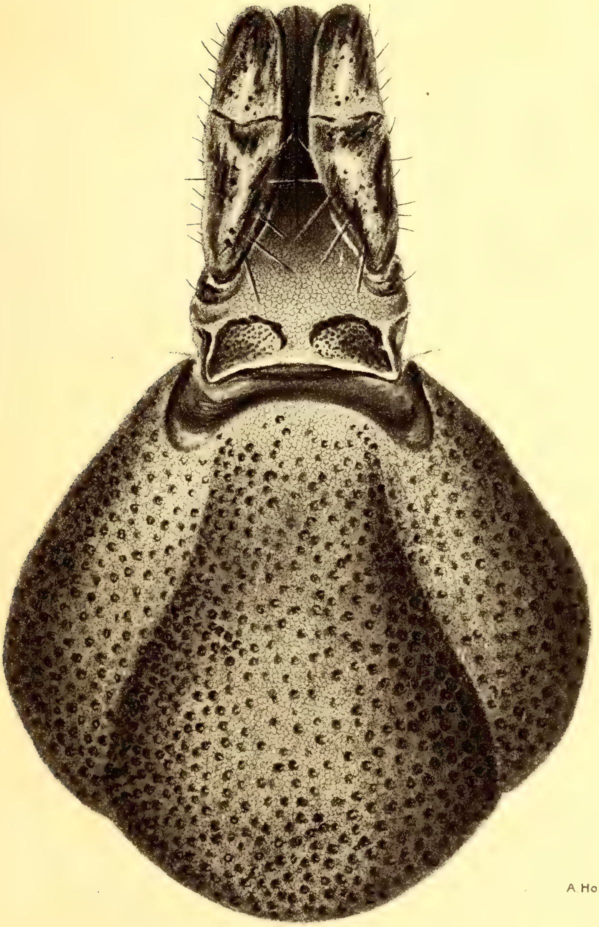

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FIG. 225. VENTRAL VIEW OF CAPITULUM OF IXODES RICINUS.

FIG. 226. DORSAL VIEW OF SCUTUM AND CAPITULUM OF FEMALE IXODES RICINUS.

THE CASTOR-BEAN TICK (*Ixodes ricinus*).[1]

(Figures 222–227.)

SPECIFIC DIAGNOSIS.—*Ixodes: Male.*—Body oval, with broader posterior border, rounded, entire; 2.5 mm. long (including capitulum), 1.5 mm. broad; deep red brown on all parts. Scutum convex, covering entire dorsal surface, except a clearer narrow marginal swelling; punctations very fine and abundant; cervical grooves very superficial. Genital orifice broad, on plane of coxæ III. Pregenital shield a third longer than broad, narrower and rounded or sinuous in front, with convex sides. Anal shield a little longer than broad, ogival, sides straight and divergent. Anus same as in female. Very apparent hairs scattered on entire surface; those of the epimeral shields having their insertions reinforced by punctiform thickenings. Capitulum 500 μ long, its base twice as broad as long and of trapeze form, open in front on the dorsal surface, a little longer than broad on the ventral surface, which has the same form as in the female. Mandibles 750 μ long, digit 180 μ long; the sheath of the stem simply corrugated transversely; internal apophysis of the digit applied against the dorsal face of the anterior half; with three points, an anterior terminal, small, one which follows immediately, larger, and a basal, feeble; the broad base not extending beyond the middle of the length of the digit; external apophysis with seven or eight teeth, the anterior progressively larger and forming a comb or crest, the posterior basal very strong. Hypostome bearing on each side a marginal series of six to eight teeth, increasing in strength from before backward;

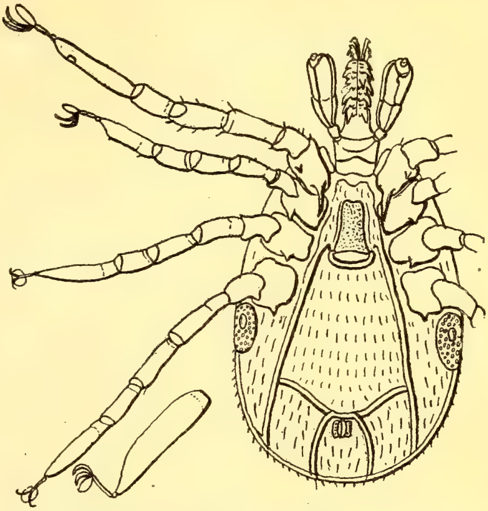

FIG. 222.—Male *Ixodes ricinus*. Ventral view. After Neumann, from Railliet, 1893, p. 707, fig. 481.

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[1] SYNONYMY AND BIBLIOGRAPHY.

1758: *Acarus reduvius* LINNÆUS, 1758, p. 615, and 1760, p. 615 [in part only; chiefly *Melophagus ovinus*]; not 1761, p. 479 [=*Acarus ovinus*, 1746, p. 346; *Reduvius*, or sheep's tick CHARLETON, 1668, p. 49; *Pediculus ovinus* RAY, 1710, p. 9; Schaf-Laus FRITSCH, 1724, pp. 40, 41, Tab. XVIII, figs. 1, 2.].—DE GEER, 1778, pp. 101–106.—FABRICIUS, 1794, p. 425.—JÖRDENS, 1801, pp. 194, 195, Tab. VII, figs. 7–9. [Given as syn. of *Ixodes reduvius* by LATREILLE, 1804, p. 51.—GERVAIS, 1844, p. 237.—CANESTRINI & FANZAGO, 1877, p. 180.—RAILLIET, 1893, p. 706.—NEUMANN, 1899, p. 112.] [See also DUGÈS, 1834c, p. 33.—LATREILLE, 1829, p. 288.] [Given as syn. of *Ixodes ricinus* by MOQUIN-TANDON, 1861, p. 302, and of *Ixodes reticulatus*, p. 303.]

1758: *Acarus ricinus* LINNÆUS, 1758, p. 615; 1760, p. 615; 1761, pp. 479, 480 [*Ricinus* CHARLETON, 1668, pp. 49, 50; *Ricinus octopodus*, the tick of RAY, 1710, p. 10; Hund-Laus, Zæcken, Tæcken of FRITSCH, 1724, p. 41, Tab. XIX].—FABRICIUS, 1794, p. 425.—DUNGLISON, 1900, p. 7. [Given as syn. of *Ixodes ricinus* by LATREILLE, 1804, p. 51.—IDEM, 1829, p. 288.—FABRICIUS, 1805, p. 351.—LEACH, 1815, p. 397.—GERVAIS, 1844, p. 236.—MOQUIN-TANDON, 1861, p. 302.—CANESTRINI & FANZAGO, 1877, p. 180.—BLANCHARD, 1890, p. 324.]

on ventral surface teeth are reduced to simple transverse crenulation. Palpi 450 μ long (70 μ, 180 μ, 200 μ, from first to third), similar to those of female, but relatively shorter and broader. Legs relatively longer and stronger, coxæ almost contiguous.

Female.—Young: Body flat, contour oval, much broader and rounded posteriorly, yellowish red; long, whitish hairs on both dorsal and ventral surface; 4 mm. long by 3 mm. broad.

[See also Gervais, 1844, p. 237; Railliet, 1893, p. 706, and Neumann, 1899, p. 112, as syn. of *Ixodes reduvius.*]

1778: *Acarus ricinoides* De Geer, 1778, pp. 98–101, pl. v, figs. 16, 17; *Acarus ricinus* Linnæus, renamed. [See also Jördens, 1801, p. 199.—Gervais, 1844, p. 236.—Canestrini & Fanzago, 1877, p. 180.—Oudemans, 1896, p. 191, and Neumann, 1899, p. 112, as syn. of *Ixodes reduvius.*]

1804: *Ixodes ricinus* (Linnæus) Latreille, 1804, p. 51.—Idem, 1806, p. 156.—Heyden, 1826, p. 610.—Idem, 1829, p. 288.—Fabricius, 1805, p. 351.—Illiger, 1807, p. 370.—Leach, 1815, pp. 397, 398.—Müller, 1817, pp. 278–287.—Treviranus, 1831, p. 191.—Gervais, 1844, p. 236.—Koch, 1844, pp. 231, 232.—Idem, 1847, pp. 20, 21.—Siebold, 1850, p. 659.—Küchenmeister, 1855, p. 422.—Milner, 1858, pp. 6, 13.—Gervais & van Beneden, 1859, p. 461.—Moquin-Tandon, 1861, p. 302.—Gerstaecker, 1863, p. 344.—Packard, 1869, p. 663.—Wagner, 1876, p. 129.—Conil, 1877, pp. 26, 27, 28.—Idem, 1878, p. 100.—Murray, 1877, pp. 190, 193.—Cobbold, 1879, p. 267.—Haller, 1880, p. 38.—Idem, 1882, pp. 309, 310, Taf. v, fig. 4.—Oudemans, 1880, p. xvii.—Idem, 1896, pp. 191, 192, 194.—Johannessen, 1885, p. 401.—Ludwig, 1886, p. 612.—Railliet, 1886, pp. 497, 498, fig. 348.—Braun, 1883, pp. 211, 212, 231, figs. 55, 56.—Idem, 1895, p. 257, figs. 127, 128.—Neumann, 1888, pp. 90, 91, fig. 47.—Idem, 1892a, pp. 95, 96, figs. 53, 55.—Idem, 1892b, pp. 98, 99, fig. 55.—Blanchard, 1890, pp. 324–326, figs. 592–594.—Idem, 1891, pp. 689–691.—Efisio, 1892, pp. 256, 257.—Janson & Tokishige, 1892, p. 349.—Mosler & Peiper, 1894, pp. 320, 321, fig. 110.—Osborn, 1896, p. 262, fig. 155.—Schneidemühl, 1896, p. 339.—Wood & Fitz, 1897, p. 346.—Weichselbaum, 1898, p. 325.—Niles, 1898a, pp. 45, 46.—Idem, 1898b, pp. 29, 30, pl. iv, figs. 3–6.—Morgan, 1899, pp. 129, 133, 134, 140, 141, pls. vii–viii, ? ix, figs. 1–5.—Mosso, 1899, p. 20.—Dunglison, 1900, pp. 596, 1093.—Salmon & Stiles, 1901, pp. 462–466, figs. 222–227. [Given as syn. of *Ixodes reduvius* by Canestrini & Fanzago, 1877, pp. 180, 184.—Canestrini, 1890, pp. 497, 498.—Railliet, 1893, p. 706.—Neumann, 1899, p. 112.—Ward, 1900b, p. 436.]

1804: *Cynorhæstes reduvius* (Linnæus) Hermann (1804), pp. 65, 66. [See also Canestrini & Fanzago, 1877, p. 180, and Neumann, 1899, p. 112, as syn. of *Ixodes reduvius.*] [See also Gervais, 1844, p. 236, as syn. of *Ixodes ricinus.*]

1804: *Cynorhæstes ricinus* (Linnæus) Hermann (1804), pp. 65, 66. [See also Canestrini & Fanzago, 1877, p. 180, and Neumann, 1899, p. 112, as syn. of *Ixodes reduvius.*]

1804: *Ixodes reduvius* (Linnæus) Latreille, 1804, pp. 51, 52.—Hahn, 1834, p. 62, fig. 152.—Gervais, 1844, pp. 237–239.—Koch, 1844, p. 232.—Idem, 1847, p. 21.—Verrill, 1870, p. 118.—Conil, 1877, pp. 26, 27.—Canestrini & Fanzago, 1877, pp. 179, 180, 184.—Murray, 1877, p. 193.—Cobbold, 1879, p. 350.—Mégnin, 1880, pp. 127–129.—Aurivillius, 1886, p. 106.—Railliet, 1886, pp. 498, 499.—Idem, 1893, pp. 706–709, figs. 480–483.—Neumann, 1888, pp. 91, 92.—Idem, 1892a, pp. 96, 97.—Idem, 1892b, pp. 99, 100.—Idem, 1899, pp. 109, 110, 111, 112–116, 120, 130, 131, 132, 156, 157, fig. 1.—Canestrini, 1890, pp. 478, 480, 489, 494–499, Tav. xliii, fig. 1; pp. 500, 502, 503, 506, 509, 532.—Blanchard, 1890, p. 327, fig. 595.—Batelli, 1891, pp. 78, 84, 99.—Osborn, 1896, p. 262.—Ward, 1900a, pp. 203, 204.—Idem, 1900b, p. 436.

Fecundated and replete female resembles a slightly depressed castor-oil bean, attains 10 to 11 mm. long by 6 to 7 mm. broad, is of ashy color, passing sometimes into the black, brown, or yellow; scutum, capitulum, and legs a shining dark brown. Scutum deep chestnut brown, oval-subpentagonal, with salient lateral borders, posterior angle rounded, anterior border slightly emarginate to receive the base of the

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[See also Kolenati, 1857, p. 24, as syn. of *Ixodes holsatus.*] [See also Neumann, 1899, p. 129, as syn. of *Ixodes hexagonus.*]

1805: "*Cynorrhæstes reduvius* Hermann," 1804, of Fabricius, 1805, p. 351, as syn. of *Ixodes ricinus.*

1805: "*Cynorrhæstes ricinus* Hermann," 1804, of Fabricius, 1805, p. 352, as syn. of *Ixodes vulgaris.*

1805: *Ixodes vulgaris* Fabricius, 1805, p. 352 [*Acarus reduvius* Linn., renamed].

1805: "*Acaruus reduvius*" Linnæus of Fabricius, 1805, p. 352, as syn. of *Ixodes vulgaris.*

1815: *Ixodes megathyreus* Leach, 1815, p. 398; hosts, dogs and *Erinaceus europæus.*—Risso, 1826, p. 182.—Gervais, 1844, p. 240.—Koch, 1844, p. 234.—Idem, 1847, p. 23.—Neumann, 1888, p. 93.—Idem, 1892a, p. 98.—Idem, 1892b, p. 101. [See also Oudemans, 1896, p. 191, and Neumann, 1899, p. 112, as syn. of *Ixodes reduvius.*]

1826: *Ixodes bipunctatus* Risso, 1826, p. 183.—Gervais, 1844, p. 241. [See also Canestrini & Fanzago, 1877, p. 180; Oudemans, 1896, p. 191, and Neumann, 1899, p. 112, as syn. of *Ixodes reduvius.*—Neumann, 1896, p. 158, as nominal species.]

1826: *Cynorhæstes Hermani* Risso, 1826, pp. 183, 184. [See also Canestrini & Fanzago, 1877, p. 180 [*C. Hermani*]; Oudemans, 1896, p. 191, and Neumann, 1899, p. 112, as syn. of *Ixodes reduvius.*]

1826: *Cynorhæstes megathyreus* (Leach) Risso (1826, p.—). [See also Canestrini & Fanzago, 1877, p. 180, as syn. of *Ixodes reduvius.*]

1829: *Crotonus ricinus* (Linnæus) Duméril, 1829, pp. 401, 402. [See also Neumann, 1899, p. 112, as syn. of *Ixodes reduvius.*]

1832: "*Chinorhæstes ricinus*" (Linnæus) Hermann of Audouin, 1832, p. 423.

1832: *Ixodes trabeatus* Audouin, 1832, pp. 420–422, pl. xiv, fig. 3 a–n.—Gervais, 1844, pp. 241, 242.—Dolly, 1894, p. 1000. [See also Oudemans, 1896, p. 191, and Neumann, 1899, p. 112, as syn. of *Ixodes reduvius.*]

1834: *Ixodes plumbeus* Dugès, 1834a, p. 20.—Idem, 1834c, pp. 33–36, pl. vii, figs. 7–12; renamed *Ixodes Dugesii* by P. Gervais. [See also *Ixodes plumbeus* (Fabricius, 1794) Fabricius, 1805, p. 353.—Neumann, 1899, p. 112, as syn. of *Ixodes reduvius.*—Osborn, 1896, p. 257, as syn. of *Boophilus bovis.*] [Not *Ixodes plumbeus* Panzer (1795, Heft 90, No. 32.).—Koch, 1844, p. 234.—Idem, 1847, p. 23.] [Not *Ixodes plumbeus* Leach, 1815, p. 397; renamed *Ixodes lividus* Koch, 1844, p. 234.—Idem, 1847, p. 23.]

1835: *Ixodes fuscus* Koch (1835), Heft 39, figs. 3, 4.—Idem, 1844, p. 232.—Idem, 1847, p. 21.—Canestrini & Fanzago, 1877, p. 184. [See also Oudemans, 1896, p. 191, and Neumann, 1899, p. 112, as syn. of *Ixodes reduvius.*] [See *Ixodes fuscous* (Say, 1821, p. —) = "*I. fuscus* Say" of Gervais, 1847, p. 352, and Neumann, 1899, p. 165.]

1835: *Ixodes lacertæ* Koch (1835), Heft 37, figs. 5–7; Heft 39, fig. 11.—Idem, 1844, p. 234.—Idem, 1847, p. 22. [See also Neumann, 1899, p. 112, as syn. of *Ixodes reduvius.*]

1866: *Ixodes pustularum* Mégnin MS. in Lucas, 1866, p. lvii; France. [Renamed *Ixodes fodiens* by Mégnin, 1867.] [See also Murray, 1877, pp. 191, 192, and Dolly, 1894, p. 1000, as syn. of *Ixodes fodiens.*—Neumann, 1899, p. 113, as syn. of *Ixodes reduvius.*]

1867: *Ixodes fodiens* Mégnin, 1867, p. 107.—Murray, 1877, pp. 191, 192, figs. 2. [See capitulum; shield extending in young specimens to the middle of the dorsal surface, relatively small in replete specimens; cervical grooves superficial; punctations fine and equal, and uniformly distributed; a few short sparse whitish hairs. Tegument covered with fine short hairs. On dorsal surface two short anterior grooves, slightly divergent; three posterior grooves: One median, straight; two lateral, concave toward median line. Genital pore at height of coxæ IV; genital grooves united in front of the vulva, and divergent caudad; two ano-marginal grooves united in an ellipse in front of the anus, divergent caudad. Anus provided with three hairs on each lip. Stigmata whitish in the young, reddish later, stigmal plate finely punctate, stigmal pore small. Capitulum 800 μ long (from postero-dorsal margin to tip of the hypostome), base elongate reniform, twice as broad as long on its dorsal surface; ventral

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also Neumann, 1899, p. 113, as syn. of *Ixodes reduvius.*—Dolly, 1894, p. 1000, as syn. of *I. pustularum.*]

Oudemans, 1896, pp. 191, 192, 194, gives also the following species as synonyms of *Ixodes ricinus:*

1758: *Pediculus cervi* Linnæus, 1758, p. 611.

? : *Acarus cardinalis* Pallas.

1794: *Acarus lipsiensis* Fabricius, 1794, p. 427=*Ixodes lipsiensis* (Fabricius) Fabricius, 1805, p. 354.—Koch, 1844, p. 234.—Idem, 1847, p. 23.—Conil, 1877, p. 27. [Given by Neumann, 1899, p. 156, as syn. of *Ixodes reduvius* or *Ixodes hexagonus.*] [See also Latreille, 1804, p. 51, as syn. of *Ixodes ricinus*, and Fabricius, 1805, p. 354, as syn. of *Ixodes lipsiensis.*]

1794: *Acarus sanguisugus* of Fabricius, 1794, p. 426=*Ixodes sanguisugus* (Linnæus) Fabricius, 1805, p. 353. [*Acarus sanguisugus* Linnæus, 1758, p. 615= *Amblyomma sanguisugum* (Linnæus) Koch, 1844, p. 230.—Idem, 1847, p. 19; unidentifiable according to Neumann, 1899, p. 283.] [See also Latreille, 1804, p. 51, as syn. of *Ixodes ricinus.*] [See also Jördens, 1801, p. 198.]

1794: *Acarus pallipes* Fabricius, 1794, p. 426=*Ixodes pallipes* (Fabricius) Fabricius, 1805, p. 352.—Koch, 1835, Heft 39, No. 10.—Idem, 1844, p. 234.—Idem, 1847, p. 22.—Conil, 1877, p. 27. [See also *Ixodes pallipes* Lucas—Gervais, 1844, p. 243.] [See also Neumann, 1899, pp. 133, 135, as syn. of *I. frontalis.*]

? : *Acarus hirudo* Fabricius, given as unidentified by Neumann, 1899, p. 166. [See also Jördens, 1801, p. 195.]

1794: *Acarus holsatus* Fabricius, 1794, p. 428=*Ixodes holsatus* (Fabricius) Fabricius, 1805, p. 355.—Koch, 1844, p. 234.—Idem, 1847, p. 23.—Conil, 1877, p. 27; given as syn. of *Ixodes reduvius* or *Ixodes hexagonus* by Neumann, 1899, p. 157. [See also Latreille, 1804, p. 51, as syn. of *Ixodes ricinus* and Fabricius, 1805, p. 355, as syn. of *Ixodes holsatus.*]

1795: *Acarus tristriatus* Panzer (1795, fasc. 59, fig. 24)=*Ixodes tristriatus* (Panzer) Koch, 1844, p. 234.—Idem, 1847, p. 23; given by Neumann, 1899, p. 157, as syn. of *Ixodes reduvius* or *Ixodes hexagonus.*

? : *Ixodes variegatus* Müller ? [See also *Ixodes variegatus* (Fabricius, 179– ?) Fabricius, 1805, p. 353.]

? : *Ixodes marginalis* Hahn. [See also *Ixodes marginalis* in Gervais, 1844, p. 242.]

1837: *Ixodes marginatus* Burmeister, 1837, p. 579. [See also *Ixodes marginatus* (Fabricius, 1794) Fabricius, 1805, p. 354.]

1835: *Ixodes sciuri* Koch, 1835, Heft 5, No. 11; Heft 37, No. 8.—Idem, 1844, p. 232.—Idem, 1847, p. 21. [See Neumann, 1899, p. 156, as syn. of *Ixodes reduvius* or *I. hexagonus.*]

1844: "*Ixodes marmoratus* Gervais," 1844, p. 241=["*Ixodes marmoratus* Risso," 1826, pp. 182, 183, given as syn. of *Ixodes reduvius* by Canestrini & Fanzago, 1877, p. 180.]

? : *Ixodes vicinus* Gervais ?—Verrill, 1870, p. 118.

? : *Ixodes talpæ* Doles.

1877: *Ixodes erinaceus* Murray, 1877 (see below, p. 468, under *Ixodes hexagonus*).

1880: "*Ixodes bovis* Riley" of Oudemans, 1880, p. xvii.

surface pentagonal, as broad in front as long, summit anterior, lateral borders convergent in back. Porose areas elongate transversely. Mandibles 1.5 mm. long, digit 150 μ, the sheath of the stem very shagreened, granular. Internal apophysis of digit elongate, with two retrograde teeth, one terminal, the other on the middle of the length, with a long stem of insertion terminated toward the posterior fourth of the digit; external apophysis with 5 teeth, increasing in size from the anterior to the posterior, the latter being strong. Hypostome elongate, lanceolate, provided on each half, besides the small teeth at the summit, with three more or less regular rows of well developed teeth: One row lateral and marginal, with strong, sharp teeth, the anterior and posterior smaller; one intermediate, with smaller teeth; and a median row scarcely extending beyond the anterior half. Palpi 800 μ long (100 μ, 360 μ, 340 μ, from first to third), digits depressed dorso-ventrally, dorsal surface flat, ventral surface excavate in an internal bevel; dorsal surface provided with sparse hairs, in a series on the median border of the ventral marginal thickness. Legs thin. Coxæ elongate, contiguous in the young, slightly separated in the replete; coxæ I prolonged on their postero-median angle by a strong spine, which strikes against coxæ II. All the articles provided with stiff hairs. Tarsi long and thin, forming, especially tarsi I, nearly a third of the length of the leg, attenuate gradually without protuberance; pulvillum nearly as long as the nails.

Nymphs and larvæ have a capitulum which recalls that of the female.

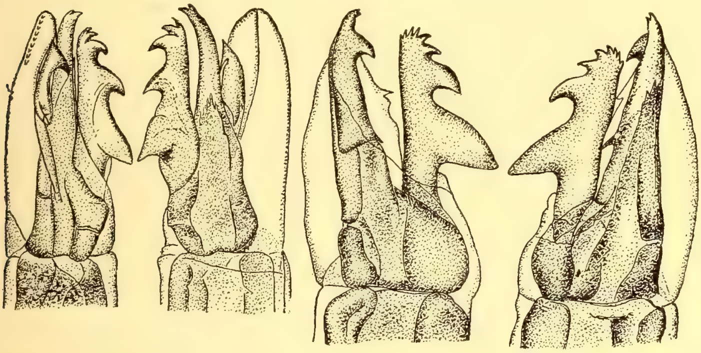

FIG. 227.—Dorsal and ventral views of digit of mandible of male and of female *Ixodes ricinus.* X 195. After Neumann, 1899, p. 114, fig. 1.

The above description is taken almost verbatim from Neumann, who has all of our specimens of this tick with the exception of a few females.

The castor-bean tick is reported from sheep, goats, cattle, horses, deer, dogs, cats, fox ferrets, hedgehogs, hares, rabbits, bats, birds, and various other animals, including man. It is found in Europe, North Africa, and North America, and it is one of the oldest and most commonly known ticks.

EUROPEAN DOG TICK (*Ixodes hexagonus*).[1]

(Figures 228–235.)

SPECIFIC DIAGNOSIS.—*Ixodes: Male.*—Body elliptical, almost as broad anteriorly as posteriorly; length 3.5 to 4 mm., breadth 2 to 2.5 mm. Brown red, legs lighter.

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[1] SYNONYMY AND BIBLIOGRAPHY.

1815: *Ixodes hexagonus* LEACH, 1815, p. 397; type host, *Erinaceus europæus*, England.—GERVAIS, 1844, p. 240.—KOCH, 1844, p. 234.—IDEM, 1847, p. 23.—CANESTRINI, Scutum covering the entire dorsal surface, except a narrow margin, lighter and elevated in a swelling; pierced all over with punctiform depressions, in the center of each of which a very short hair is inserted. The genital pore opposite the intercoxal space between coxæ II and III. Pregenital shield a little broader than long, narrowed posteriorly into a narrow base, rectangular, anteriorly very much widened and sinuous. Anal shield ogival, sides slightly divergent, almost twice as long as broad. Epimeral shields reinforced laterally by chitinous plates; toward the median line by punctations of the same kind bearing hairs. The entire ventral surface provided with fine hairs. Anus like that of the female. Capitulum 520 μ long (from its dorsal border to the tip of the hypostome), at the base almost twice as broad as long on its dorsal surface, which is almost rectangular, a little longer than broad on its ventral surface, which is also almost rectangular. Mandibles with digit 165 μ long; sheath and denticles of mandibles as in male *Ixodes ricinus*. Hypostome and palpi like those of male *Ixodes ricinus*, except that the lateral denticles of the former are half as strong, the ventral crenulations more marked, each formed by three denticles united at the extremities of their base. Legs like those of the female, relatively longer and stronger, coxæ nearly contiguous, the retrograde spine of the first pair stronger, but a little less so than that of the male of *Ixodes ricinus*.

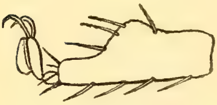

FIG. 229.—Tarsus IV of *I. hexagonus*. X 60. After Neumann, from Railliet, 1893, p. 710, fig. 485.

Female.—Like that of *Ixodes ricinus*, except for the following differences: Scutum less oval, more lozenge-shaped, with lateral angles more pronounced, the sides a little excavate in their posterior half, the posterior angle narrower; punctations larger. In young specimens the dorsal surface has a marginal groove rather distant from the margin; this presents posteriorly four small indentations formed by the prolonging of the ventral grooves. Genital pore at height of last intercoxal space. Anus more anterior; anomarginal grooves longer, united in a point (ogival) anterior of the anus. Capitulum shorter (700 μ); mandibles with digit 160 μ long; hypostome a little shorter, with lateral denticles less salient, the median row very short, reduced to three or four anterior denticles; palpi shorter, the third article almost as long as the second. Legs relatively shorter, thicker, especially the tarsi; coxæ I with retrograde tooth less strong shorter; tarsi thick, short, swollen toward the extremity, which is preceded by a very salient gibbosity; pulvillum attains almost the middle of the length of the claws.

As Neumann has all of our specimens of this form, we have taken his diagnosis almost verbatim. This tick is reported both from the United States and from Europe, and has been found on dogs, cattle,

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1890, pp. 481, 489, 498, 499, 500, Tav. XLIII, fig. 2.—Batelli, 1891, pp. 78, 81, 98.—Railliet, 1893, pp. 709, 710, fig. 485.—Neumann, 1899a, pp. 109, 110, 111, 129–132, 156, 161, fig. 10.—Idem, 1899b, pp. 464–465.—Ward, 1900a, p. 204, fig. 1.—Idem, 1900b, p. 436, fig. 257.—Salmon & Stiles, 1901, pp. 467, 468, figs. 228–235.

1815: *Ixodes autumnalis* Leach, 1815, p. 398; type host, *Canis familiaris*, England.—Gervais & van Beneden, 1859, p. 461. [See also Neumann, 1899, p. 129, as syn. of *I. hexagonus*.]

1832: *Ixodes erinacei* Audouin, 1832, pp. 415–419, pl. XIV, fig. 2 *a–u;* type host, *Erinaceus*.—Gervais, 1844, p. 242.—Haller, 1882, pp. 310, 311.—Batelli, 1891, p. 98. [See also Canestrini, 1890, p. 500, and Neumann, 1899, p. 129, as syn. of *I. hexagonus*.—Murray, 1877, p. 190, renamed *I. erinaceus*.]

1832: "*I. reduvius* Linnæus" of Audouin, 1832, p. 422, pl. XIV, fig. 4. [See also Neumann, 1899, p. 129, as syn. of *I. hexagonus*.]

1837: *Ixodes sexpunctatus* Koch (1837), Heft 39, figs. 5, 6.—Idem, 1844, p. 233.—Idem,

PLATE XCV.

Fig. 228.—Male *Ixodes hexagonus*. Ventral view. After Neumann, 1899, p. 130, fig. 10.

Fig. 230.—Female *I. hexagonus*. Natural size. After Berlese, 1892, fasc. 61 (10).

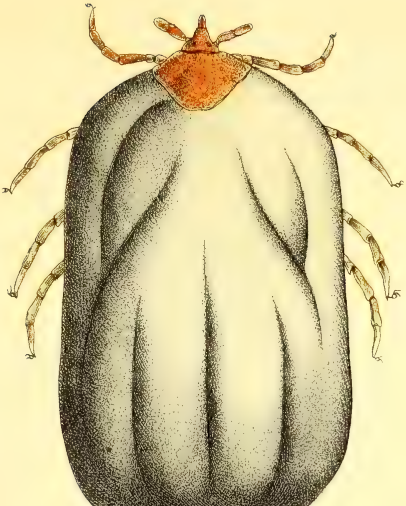
Fig. 231.—The same enlarged. After Berlese, 1892, fasc. 61 (10), fig. 1.

Fig. 232.—Ventral view, in outline. After Berlese, 1892, fasc. 61 (10), fig. 2.

Fig. 233.—Capitulum of same. After Berlese, 1892, fasc. 61 (10), fig. 3.

Fig. 234.—Scutum of same. After Berlese, 1892, fasc. 61 (10), fig. 4.

Fig. 235.—Stigmen of same. After Berlese, 1892, fasc. 61 (10), fig. 5.



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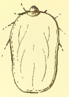

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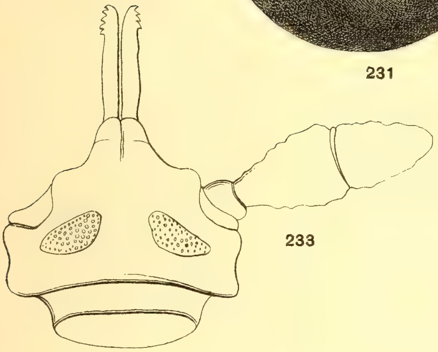

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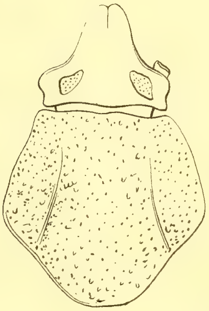

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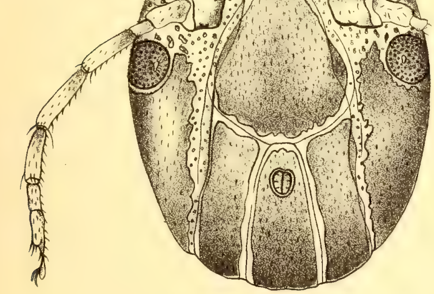

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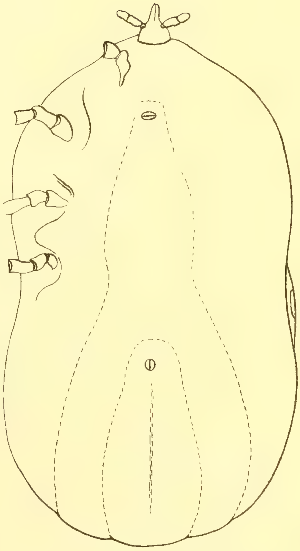

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A Hoen & Co., Lithocaustic

FEMALE IXODES HEXAGONUS.

sheep, foxes, hares, squirrels, porcupines, gophers, cats, and various other hosts, including man, and several kinds of birds.

Genus Eschatocephalus[1] Frauenfeld, 1853.

Generic diagnosis.—*Ixodinæ:* Capitulum long. Palpi pyriform (male), claviform (female). Eyes wanting. Anal groove surrounding anus in front and opening caudad. Stigmata circular in both sexes. Dorsal and ventral irregular chitinous thickenings in the male; striæ or very fine parallel grooves in the female. Legs ordinarily long.

Type species.—*Eschatocephalus gracilipes = vespertilionis.*

Neumann mentions seven species of this genus, but none of them appear to have been reported for North America.

Genus Aponomma[2] Neumann, 1899.

Generic diagnosis.—*Ixodinæ:* Eyes wanting. Base of capitulum usually pentagonal, the dorso-lateral border very short. Palpi long. Male as broad or nearly as

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1847, p. 22. [See also Canestrini, 1890, p. 500, and Railliet, 1893, p. 709, as syn. of *I. hexagonus.*—Neumann, 1899, p. 156, as probable syn. of *I. reduvius* or *I. hexagonus.*]

1837: ? *Ixodes crenulatus* Koch (1837), Heft 39, figs. 5, 6.—Idem, 1844, p. 233.—Idem, 1847, p. 22.—Canestrini & Fanzago, 1877, pp. 184, 185. [See also Neumann, 1899, pp. 129, 132, as doubtful syn. of *I. hexagonus.*]

1861: *Ixodes vulpis* Pagenstecher (1861), II, p. 40, pl. I, figs. 12–13.—Conil, 1877, p. 28. [See also Canestrini, 1890, p. 498.—Railliet, 1893, p. 709.—Neumann, 1899, p. 129, as syn. of *I. hexagonus.*]

1877: *Ixodes erinaceus* Murray, 1877, p. 190, figs. 3, p. 195 (*Ixodes erinacei* Audouin, renamed).—Dolly, 1894, p. 1000.—Osborn, 1896, p. 262. [See also Oudemans, 1896, p. 191, as syn. of *Ixodes ricinus,* and Neumann, 1899, pp. 129, 161, as syn. of *I. hexagonus.*]

1880: "*Ixodes ricinus* Linnæus" of Mégnin, 1880a, p. 129. [See also Canestrini, 1890, p. 498.—Railliet, 1893, p. 709.—Neumann, 1899, p. 129, as syn. of *I. hexagonus.*]

1893: "*Ionus hegxa* Leach" of Railliet, 1893, p. 709 (misprint for *I. hexagonus*).

[1] Synonymy and Bibliography.

1853: *Eschatocephalus* Frauenfeld, 1853, pp. 54–58; type, *gracilipes.*—Marx, 1892, pp. 233, 234.—Morgan, 1899, pp. 136, 137. [See also Neumann, 1899, pp. 166, 167, 168, 172, as syn. of *Hæmalastor.*]

1857: *Sarconissus* Kolenati, 1857, pp. 21–23.—Idem (1860, p. 537); type, *flavipes= E. gracilipes=E. vespertilionis.*—[See also Canestrini, 1890, p. 480.]

1857: "*Hæmalastor* Koch" of Kolenati, 1857, p. 23.—Neumann, 1897, p. 325.—Idem, 1899, pp. 107, 108, 166–180.

1877: "*Sarconyssus* Kolenati" of Murray, 1877, p. 195.—Marx, 1892, p. 235.—Morgan, 1899, p. 138. [See also Neumann, 1899, pp. 166, 167, 168, as syn. of *Hæmalastor.*]

[2] Synonymy and Bibliography.

1877: *Ophiodes* Murray, 1877, pp. 203, 204; type, *Gervaisii.* [Not *Ophiodes* Wagl., 1841, rept.; Hart, 1852, hym.; Hincks, 1866, coel.] [See also Neumann, 1899, p. 180, renamed *Aponomma.*]

1899: *Aponomma* Neumann, 1899, pp. 107, 108, 109, 180–200. [*Ophiodes* Murray, renamed.]—**Salmon & Stiles, 1901, pp. 469, 470.**

broad as long; ventral surface naked, sexual grooves very divergent caudad, anal groove semicircular or ogival, opening in front, uniting the sexual grooves; anomarginal grooves single. Scutum covering entire dorsal surface and usually marked with metallic green spots. Stigmata comma-shaped. Female with scutum shorter than broad or scarcely longer than broad, usually marked with three metallic green spots arranged in a triangle. Ventral grooves as in male. Stigmata shorter, less attenuate at postero-lateral extremity.

TYPE SPECIES.—*Aponomma Gervaisi.*

The members of this genus live almost exclusively on reptiles. None of the forms thus far reported appear to be North American. Neumann gives the following key to the species:

KEY TO THE SPECIES OF THE GENUS APONOMMA.

Males	1
Females	8

A.—Male.

1.	*Scutum marked with green metallic spots*	2
	Scutum not marked with green metallic spots	3
2.	*Said spots five in number*	*A. Gervaisi.*
	Said spots nine in number	*A. exornatum.*
3.	*Scutum without deep marginal groove*	4
	Scutum with deep marginal groove	6
4.	*Scutum channeled by fossettes; body broader than long*	*A. transversale.*
	Scutum level; body as long as broad or longer	5
5.	*Tarsi II to IV narrowed at the extremity*	*A. læve.*
	Tarsi II to IV provided with tuberosity at extremity	*A. politum.*
6.	*Scutum marked with lighter spots*	*A. decorosum.*
	Scutum of uniform color, reddish brown	7
7.	*Tarsi II to IV, narrowed at extremity*	*A. trachysauri.*
	Tarsi II to IV, with tuberosity at extremity	*A. concolor.*

B.—Female.

8.	*Scutum marked with three metallic green spots*	9
	Scutum reddish brown, of uniform color, without green spots	11
9.	*Scutum at least as broad as long, punctations large, not close together*	*A. Gervaisi.*
	Scutum as long as broad, or longer, punctations fine, close	10
10.	*Tarsi calcarate*	*A. exornatum.*
	Tarsi not calcarate	*A. trimaculatum.*
11.	*Body much broader than long*	*A. transversale.*
	Body longer than broad	12
12.	*Scutum broader than long*	13
	Scutum as long as broad, triangular	14
13.	*Scutum with few fine punctations*	*A. læve.*
	Scutum with numerous deep punctations	*A. trachysauri.*
14.	*Tarsi three times as long as broad*	*A. decorosum.*
	Tarsi at least four times as long as broad	*A. hydrosauri.*

GENUS AMBLYOMMA[1] Koch, 1844.

GENERIC DIAGNOSIS.—*Ixodinæ:* Eyes usually flat, slightly salient, sometimes hemispherical, brilliant, in a submarginal depression of the scutum. Capitulum long, with valvate palpi. Anal groove semicircular, opening cephalad, uniting the sexual grooves; ordinarily no median ano-marginal groove. Scutum often marked with color designs. No anal plates in the male. Stigmata usually triangular, with rounded angles. Nearly always 11 posterior marginal festoons, especially in the male.

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[1] SYNONYMY AND BIBLIOGRAPHY.

1844: *Amblyomma* KOCH, 1844, pp. 223–231.—IDEM, 1847, pp. 15–20.—FÜRSTENBERG, 1861, p. 208.—MURRAY, 1877, pp. 187, 188, 201–203.—BERTKAU, 1880, pp.

TYPE SPECIES.—*Amblyomma cajennense.*

Neumann has mentioned 86 species of *Amblyomma*, some of which are doubtful, and many of which are found on the American continent and adjacent islands. In his key to the genus he gives only three species, namely, *A. americanum*, *A. maculatum*, and *A. tuberculatum*, as occurring in the United States, and one species, *A. multipunctum*, for "North America." Of these, the Lone Star Tick (*A. americanum*) is quite common on cattle.

The following key to the species is translated from Neumann:

KEY TO THE SPECIES OF THE GENUS AMBLYOMMA.

[For forms reported in the United States, follow Roman type.]

Males	1
Females	47

A.—Male.

1.	Postero-marginal festoons present	2
	Postero-marginal festoons absent (Africa)	*A. hippopotamense.*
2.	Marginal groove present	3
	Marginal groove absent	28
3.	Marginal groove extending around the posterior border	4
	Marginal groove not extending around the posterior border	24
4.	Eyes flat	5
	Eyes hemispherical, in sockets (Africa, Gaudeloupe, Guatemala)	*A. variegatum.*
5.	Scutum dark, with or without copper or yellowish white spots	6
	Scutum light, with or without dark designs	20
6.	Scutum without black spot occupying anterior third	7
	Scutum black in anterior third (Port Natal)	*A. annulipes.*
7.	Coxæ I spinose	8
	Coxæ I bilobed (Africa)	*A. rugosum.*
8.	Coxæ I bicuspid	9
	Coxæ I armed with one long spine	*A. maculatum.*
9.	Coxæ I divided on posterior margin	10
	Coxæ I divided nearly to anterior margin (Mexico, Paraguay)	*A. ovale.*

109, 110.—CANESTRINI, 1890, pp. 483, 486, 488.—MARX, 1892, pp. 233, 235.—OSBORN, 1896, p. 261.—NEUMANN, 1897, p. 325.—IDEM, 1899, pp. 107, 108, 109, 200–283.—MORGAN, 1899, p. 138.—WARD, 1900a, pp. 204, 205.—IDEM, 1900b, p. 436.—SALMON & STILES, 1901, pp. 470–477. [See also RAILLIET, 1893, p. 710, as syn. of *Hyalomma.*]

1844: *Hæmalastor* KOCH, 1844, p. 223; type, *longirostris.*—IDEM, 1847, p. 15.—FÜRSTENBERG, 1861, p. 208.—MURRAY, 1877, pp. 187, 198.—MARX, 1892, pp. 233, 235.—TROUESSART, 1892, p. 47.—MORGAN, 1899, p. 138.—NEUMANN, 1899, pp. 166–180. [See also CANESTRINI, 1890, pp. 482, 483, 486.] [See also NEUMANN, 1901, MS., as syn. of *Amblyomma.*]

1863: *Ixodes* (*Amblyomma*) Koch in GERSTAECKER, 1863, p. 344.

1863: *Ixodes* (*Hæmalastor*) Koch in GERSTAECKER, 1863, p. 344.

1898: "*Amblyomnia*" of DALRYMPLE, MORGAN, and DODSON, 1898, p. 241 (misprint for *Amblyomma*).

10. Spine of coxæ IV as long as coxæ or nearly so 11
Spine of coxæ IV shorter than coxæ 12
11. *Punctations of scutum lacking from the triangular projections, flat, radiating in posterior half* (Mexico, Central and South America) ...... *A. cajennense.*
Punctations distributed over entire surface of scutum ...... *A. americanum*, p. 474.
12. *Marginal swelling smooth or punctate* 13
Marginal swellings longitudinally striated (Australia) ...... *A. triguttatum.*
13. *Scutum with light, median, anterior spot* 14
Scutum without light median spot 15
14. *Anterior spot on scutum separated from postero-median spot by transverse band* (Africa) ...... *A. Hassalli.*
Anterior median spot connected with the postero-median spot (Africa) ...... *A. splendidum.*
15. *Punctations of scutum very numerous on entire surface* 16
Punctations few, absent from some places 19
16. *Spines of coxæ I short* 17
Spines of coxæ I very long (Central and South America) ...... *A. fossum.*
17. *Spine of coxæ IV very short and feeble* 18
Spine of coxæ IV long and strong; body broad (Mexico) ...... *A. coelebs.*
18. *Punctations very fine, obsolete* (Brazil) ...... *A. concolor.*
Punctations large, unequal (South America) ...... *A. Geayi.*
19. *Punctations of scapular angles large, about 10 in number* (on *Spilotes variabilis*) (Mexico and Central America or South America?) ...... *A. sparsum.*
Punctations of scapular angle very fine, 20 at least (French Guiana) ...... *A. paulopunctatum.*
20. *Design on scutum forming an* H *and a* Y *consecutively* (Africa) ...... *A. eburneum.*
Design on scutum not forming an H *or a* Y 21
21. *A complete transverse band near middle of length* (Africa) ...... *A. subluteum.*
No such band present 22
22. *A linear postero-median spot present* 23
No such spot present (?) ...... *A. clypeolatum.*
23. *Linear postero-median spot separated from anterior spots* (Africa) ...... *A. hebræum.*
Linear postero-median spot continuous with anterior spots (Africa) ...... *A. marmoreum.*
24. *Body broad, sides rounded* 25
Body straight, at least anterior portion, sides nearly straight 27
25. *Marginal groove continuous* (Australia) ...... *A. moreliæ.*
Marginal groove formed of punctations 26
26. *No* [*?*] *antero-lateral light spots* (Australia) ...... *A. limbatum.*
Antero-lateral light spots present (Africa) ...... *A. latum.*
27. *Coxæ I with two very long spines* (Brazil) ...... *A. striatum.*
Coxæ I with two short spines (Congo) ...... *A. cuneatum.*
28. Eyes flat 29
Eyes in orbit (Cape of Good Hope) ...... *A. sylvaticum.*
29. Punctations large and deep 30
Punctations small 43
30. Coxæ II and III spinose or tuberculose 31
Coxæ II and III unarmed (Africa) ...... *A. Fodi.*
31. Body short, usually broader near the middle, sides rounded 32
Body long, broader in back, sides nearly straight 42
32. Punctations equal or subequal, large, abundant 33
Punctations unequal, some large, others very fine 40
33. Coxæ IV with one spine 34
Coxæ IV with two short spines (Uruguay) ...... *A. gypsatum.*
34. *Spine on coxæ IV short* 35
Spine on coxæ IV long 41

35. *Tarsi long, not suddenly narrowed* ... 36
Tarsi short, suddenly narrowed or tuberose ... 37
36. *Scutum raised in non-punctate elevations* (Mariana Islands, Philippines?) . *A. cyprium.*
Scutum level, median field with few punctations (Java) ... *A. quadrimaculatum.*
37. *Spines on coxæ I well developed* ... 38
Spines on coxæ I very short, in forms of tuberosities (Central and South America) ... *A. scutatum.*
38. *Second palpal article only one and one-half times as long as broad* (Central and South America) ... *A. nodosum.*
Second palpal article much longer than broad ... 39
39. *Punctations on entire surface of scutum* (South America) ... *A. Göldii.*
Punctations on scutum lacking in some places; body broad (Cochin China, Java, Borneo) ... *A. testudinarium.*
40. *Scutum yellow with brown spots; coxal spines conical* (Central and South America) ... *A. dissimile.*
Scutum brown with whitish scapular spots; coxal spines flat (Brazil) ... *A. humerale.*
41. *Hypostome with six rows of denticles* (South America) ... *A. calcaratum.*
Hypostome with eight rows of denticles (North America) ... *A. multipunctum.*
42. *Hypostome with six rows of denticles* (South America) ... *A. varium.*
Hypostome with eight rows of denticles (Nicaragua) ... *A. crassipunctatum.*
43. Tarsi narrowed suddenly ... 44
Tarsi narrowed gradually ... 46
44. Coxæ I with subequal teeth; coxæ II and III spinose ... 45
Coxæ I with unequal teeth; coxæ II and III unarmed (Africa) ... *A. Tholloni.*
45. Body short oval; scutum variegated ... *A. tuberculatum.*
Body subtriangular, scutum of uniform color (Brazil?) ... *A. fulvum.*
46. *Coxæ I unicuspid; scutum with white spots* (Cuba, Brazil) ... *A. albopictum.*
Coxæ I bicuspid; scutum with metallic spots (Philippines) ... *A. decoratum.*

B.—Female.

47. Eyes flat ... 48
Eyes in orbits ... 87
48. Coxæ I bicuspid ... 49
Coxæ I armed with one very long spine ... *A. maculatum.*
49. Scutum provided with punctations ... 50
Scutum smooth (Port Natal) ... *A. læve.*
50. Abdomen of uniform color ... 51
Abdomen with two red, symmetrical dorsal spots (Africa) ... *A. hippopotamense.*
51. Scutum brown or marked with lighter spots ... 52
Scutum yellow with dark spots ... 84
52. Scutum broader than long or as broad as long ... 53
Scutum oval or lozenge shape, longer than broad ... 86
53. Scutum triangular, postero-lateral borders nearly straight ... 54
Scutum cordiform, oval, or pentagonal, postero-lateral borders convex ... 69
54. Scutum medium size, 2 to 3.5 mm. long ... 55
Scutum very large, 5 mm. long (Cape of Good Hope) ... *A. crenatum.*
55. Scutum as broad or scarcely broader than long ... 56
Scutum much broader than long (Congo) ... *A. breviscutatum.*
56. *Eyes in front of anterior third of scutum* ... 57
Eyes at plane of or behind anterior third of scutum ... 63
57. *Eyes toward the anterior fourth of scutum* ... 58
Eyes in front of anterior fourth of scutum ... 61

58. *Scutum medium, a little broader than long, without spots, or with yellowish white spots* 59

Scutum large, as long (3.3 mm.) as broad, with red copper spots 60

59. *Scutum with yellowish white spots; punctations not confluent* (Mexico, Central and South America) .... *A. cajennense.*

Scutum without spots; punctations confluent in lines (Galapagos) .... *A. pilosum.*

60. *Eyes included in scutum* (Africa) .... *A. Hassalli.*

Eyes extending beyond scutum laterally (Singapore) .... *A. extraoculatum.*

61. *Median field of scutum with large posterior spot* 62

Median field of scutum without spot (Port Natal) .... *A. annulipes.*

62. *Scutum with spots lateral of cervical grooves* (Africa) .... *A. eburneum.*

Scutum without such lateral spots (Africa) .... *A. splendidum.*

63. *Coxæ I with two short teeth* 64

Coxæ I bidentate, one or both teeth very long 67

64. *Tarsi not suddenly narrowed; punctations deep* 65

Tarsi suddenly narrowed at the extremity 66

65. *Coxæ I with two sharp spines; coxæ II–IV each with one tuberosity* (Brazil) .... *A. parviscutatum.*

Coxæ I with two blunt spines; coxæ II–IV each with two tuberosities (Guatemala) .... *A. sabaneræ.*

66. *Punctations large, deep* (Cochin China, Java, Borneo) .... *A. testudinarium.*

Punctations small, superficial (Africa) .... *A. Tholloni.*

67. Coxæ I with one very long spine .... *A. americanum.*

Coxæ I with two long spines 68

68. *Eyes toward the middle of the length of the scutum* (Brazil) .... *A. striatum.*

Eyes toward the anterior third of the scutum (Bolivia) .... *A. vittatum.*

69. *Dorsal surface of capitulum with deep groove lateral of porose areas* (Australia) .... *A. triguttatum.*

Dorsal surface of capitulum without such grooves 70

70. *Scutum broader than long* 71

Scutum as long as broad or scarcely broader than long 75

71. *Two spines on coxæ I long, close together, parallel* (Central and South America) .... *A. fossum.*

Two spines on coxæ I short, separated, divergent 72

72. *Coxal spines conical, strong* (Banda Islands) .... *A. cordiferum.*

Coxal spines flat, rudimentary on coxæ II–IV 73

73. *Punctations coarse, at least in part* 74

Punctations very fine (Siam) .... *A. sublæve.*

74. *Hypostome with six rows of denticles; scutum 3.5 mm. broad* (Mariana Islands, Philippines) .... *A. cyprium.*

Hypostome with eight rows of denticles; scutum 1.7 mm. broad (Colombia) .... *A. deminutivum.*

75. *Eyes toward the middle of the length of the scutum* 76

Eyes in front of the middle of the length of the scutum 78

76. *Punctations very fine; scutum pentagonal* (Brazil) .... *A. concolor.*

Punctations coarse, deep; scutum oval 77

77. *Scutum without large median spot; second palpal article twice as long as third* (Central and South America) .... *A. nodosum.*

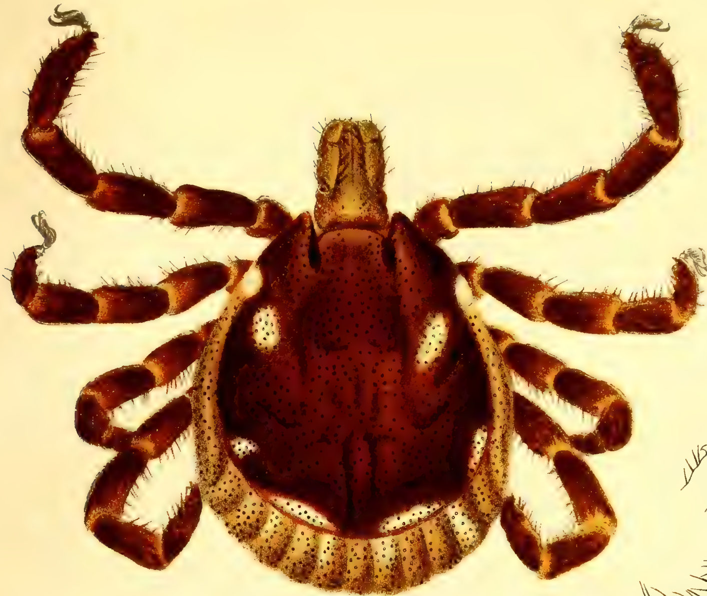
Scutum with large median spot; second palpal article three times as long as third (South America) .... *A. calcaratum.*

78. *Punctations few* 79

Punctations numerous; spines on coxæ IV rudimentary 80

79. *Coarse punctations not scarce (about 30)* (Central and South America) .... *A. dissimile.*

Coarse punctations scarce (3 or 4) (Australia) .... *A. limbatum.*



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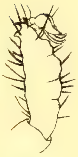

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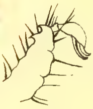

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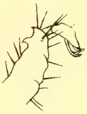

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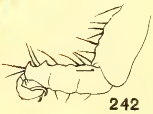

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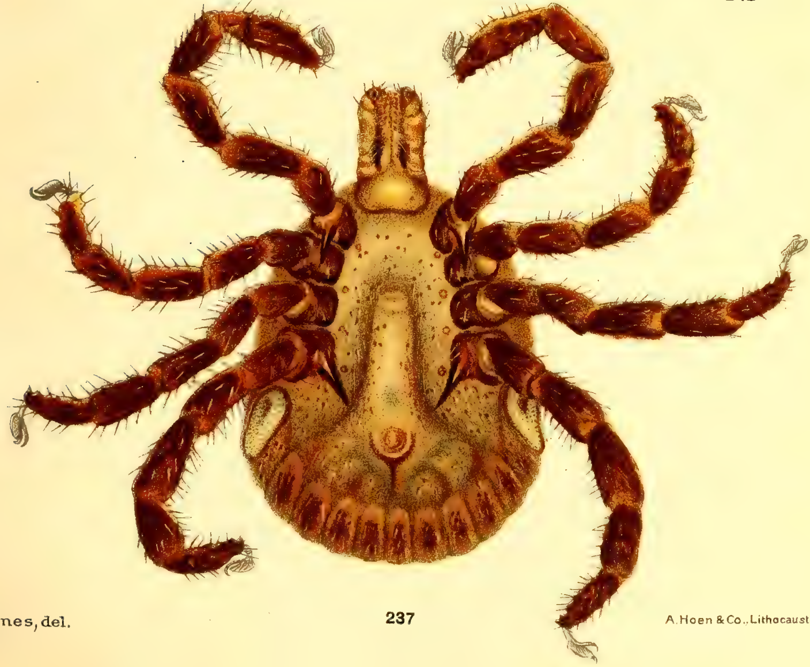

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FIG. 236. DORSAL VIEW OF MALE AMBLYOMMA AMERICANUM; MARYLAND. GREATLY ENLARGED. ORIGINAL FROM LIFE.

FIG. 237. VENTRAL VIEW OF SAME.

FIGS. 239, 240, 241, 242. TARSI I, II, III, IV OF FIG. 236.

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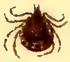

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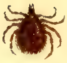

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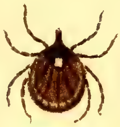

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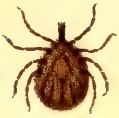

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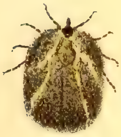

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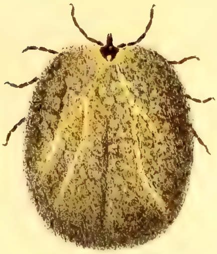

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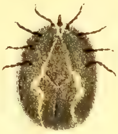

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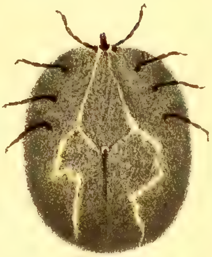

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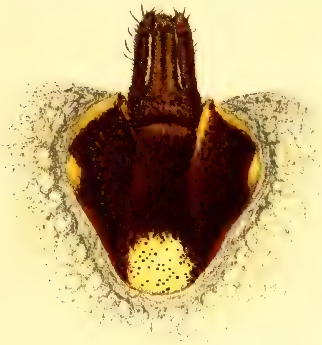

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FIG. 243. MALE AMBLYOMMA AMERICANUM. NATURAL SIZE. ORIGINAL.

FIG. 244. THE SAME. X2.

FIG. 245. VENTRAL VIEW OF SAME. NATURAL SIZE.

FIG. 246. THE SAME. X2.

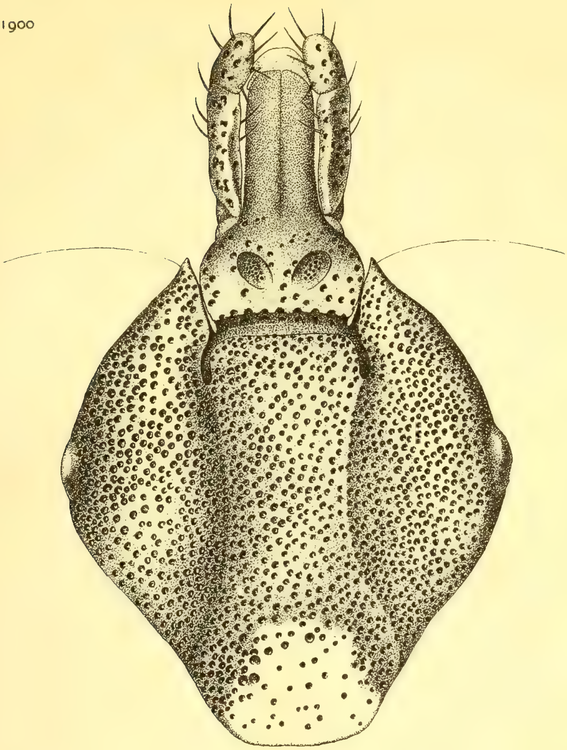
FIGS. 247, 248. DORSAL VIEW OF YOUNG AND OLD FEMALE AMBLYOMMA AMERICANUM. NATURAL SIZE. ORIGINAL FROM NATURE.

FIGS. 249, 250. THE SAME. X2.

FIGS. 251, 252. VENTRAL VIEW OF SAME. NATURAL SIZE.

FIGS. 253, 254. THE SAME. X2.

FIG. 255. SCUTUM AND CAPITULUM OF FEMALE AMBLYOMMA AMERICANUM. ENLARGED FROM LIFE. ORIGINAL.



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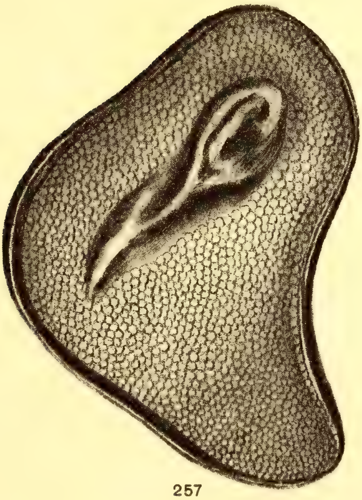

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FIG. 256. SCUTUM AND CAPITULUM OF FEMALE AMBLYOMMA AMERICANUM. GREATLY ENLARGED. ORIGINAL.

FIG. 257. LEFT STIGMEN OF FEMALE AMBLYOMMA AMERICANUM. GREATLY ENLARGED. ORIGINAL.

80. *Scutum pentagonal, punctations equal* (Spain) .... *A. dubitatum.*
Scutum cordiform, punctations larger in anterior angles 81
81. Scutum large (4 to 5 mm.); lateral copper-colored spots .... *A. tuberculatum.*
Scutum median (2.5 mm. or less) 82
82. *Hypostome with six rows of denticles* 83
Hypostome with eight rows of denticles; a tubercle on coxæ III and IV (Viti-Levou Islands) .... *A. acutangulatum.*
83. *Coxæ III and IV with one tubercle each* (Central and South America) . *A. scutatum.*
Coxæ III and IV with two tubercles each (South America) .... *A. Göldii.*
84. *Scutum cordiform (5.5 mm. broad); tarsi gradually narrowed* (Zanzibar) . *A. aureum.*
Scutum triangular, 2 to 4 mm. broad 85
85. *Eyes toward anterior third of scutum* (Cochin China, Java, Borneo) .... *A. testudinarium.*
Eyes toward anterior fourth of scutum (Africa) .... *A. devium.*
86. *Scutum oval, punctations numerous on entire surface* (Trinidad) ...... *A. giganteum.*
Scutum lozenge shaped, punctations rare in the middle (*Nymph*) (Trinidad) . *A. avicola.*
87. *Scutum triangular, deep brown* (Africa, Guadeloupe, Guatemala) .. *A. variegatum.*
Scutum cordiform, yellowish white (Cape of Good Hope) .... *A. sylvaticum.*

THE LONE STAR TICK (*Amblyomma americanum*).[1]

(Figures 236–255.)

SPECIFIC DIAGNOSIS.—*Amblyomma: Male.*—Body oval, much enlarged caudad, brown red, lighter on the marginal ridge; 3 to 3.5 mm. long (capitulum included), 2.5 mm. broad. Scutum somewhat convex; cervical grooves not very deep, prolonged backward by a superficial depression; marginal grooves narrow, commencing a little in back of the eyes near the margin at its origin, very widely separated from the posterior margin where the ridge which it limits is three to four times as broad and divided into eleven festoons deeply separated and twice as long as broad; frequently two linear oblique spots, metallic silver, or gold, to green, postero-median of the eyes; two other small symmetrical spots, metallic silver, or gold, to green (after remaining in alcohol), tangential to postero-marginal shields in front of the marginal groove; other similar spots on the festoons. Eyes large, flat, yellowish to white. Punctations numerous, very fine. Ventral surface yellow ocher provided with fine, short, sparse hairs; dorso-submedian porose plates slightly posterior of coxæ IV; dark ramifications of the intestine sometimes visible. Genital pore at height of intercoxal space of coxæ II and III. Anus slightly in front of posterior quarter of the body. Stigmata large, whitish, elongate, comma-shaped, curved outward; stigmal pore anterior, small. Capitulum relatively long (0.9 to 0.96 mm.); base short, broad, postero-lateral angles rounded, not very prominent. Mandibles with digit 135 μ long; internal apophysis broad, transverse; external apophysis with two teeth, one terminal very small, the other very strong. Hypostome subspatulate with three rows of teeth on each half, the median rows contiguous. Palpi long, thin, the second article at least twice as long as the third. Legs medium; coxæ I bicuspid, lateral spine much longer; coxæ II and III provided with a very short and broad spine on their posterior border; coxæ IV with a strong and long spine. Tarsi I nearly four times as long as broad, rather brusquely narrowed near the tip; tarsi II to IV three times as long as broad with two consecutive spurs; pulvillum half as long as the hooks.

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[1] SYNONYMY AND BIBLIOGRAPHY.

1758: *Acarus americanus* LINNÆUS, 1758, p. 615; 1760, p. 615 [*Acarus ovalis planus, macula dorsali alba* KALM, 1754, p. 20, from Pennsylvania and New Jersey].—FABRICIUS, 1794, p. 428.—JÖRDENS, 1801, pp. 195–198, Tab. VII, figs. 10–13. [Not *Acarus americanus*, *A. nigua*, from Brazil, of TREVIRANUS, 1831, pp. 185–191, Taf. XV, XVI.] [Renamed *Acarus nigua* by DE GEER, 1778, p. 154.] [See also LATREILLE, 1804, p. 52, as syn. of *Ixodes nigua.*—IDEM, 1829, p. 288.—GERVAIS & VAN BENEDEN, 1859, p. 461.—SIEBOLD, 1850, p. 659 (pars).—MOQUIN-TANDON, 1861, p. 303.] [See also FABRICIUS, 1805, p. 356, as syn. of *Ixodes americanus.*] [See also NEUMANN, 1897, p. 365, as syn. of *Dermacentor americanus.*] [See also DUNGLISON, 1900, p. 7, as syn. of "*Pulex penetrans.*"]

1778: *Acarus nigua* DE GEER, 1778, pp. 153–160, pl. XXXVII, figs. 7–13. *Acarus americanus* Linnæus, renamed. [Not "*Acarus nigua*" of TREVIRANUS, 1831.] [See also LATREILLE, 1829, p. 288.] [See also MOQUIN-TANDON, 1861, p. 303, and MURRAY, 1877, p. 194, as syn. of *Ixodes americana.*] [See also RAILLIET, 1893, pp. 7–14; NEUMANN, 1897, p. 365, as syn. of *Dermacentor americanus.*]

1804: *Ixodes nigua* (De Geer) LATREILLE, 1804, pp. 52, 53.—GERVAIS & VAN BENEDEN, 1859, p. 461.—MOQUIN-TANDON, 1861, p. 303.—BLANCHARD, 1890, p. 328.

1804: *Rhynchoprion americanum* (Linnæus) HERMANN (1804, p. —). [See FABRICIUS, 1805, p. 356, as syn. of *Ixodes americanus.*—GERVAIS, 1844, p. 247.]

1805: *Ixodes americanus* (Linnæus) FABRICIUS, 1805, pp. 355, 356.—ILLIGER, 1807, pp. 368–370.—GERVAIS, 1844, pp. 247, 248.—KÜCHENMEISTER, 1855, p. 422, in part.—MILNER, 1858, p. 13.—FITCH, 1871, pp. 363–366.—LINTNER, 1874, p. 631.—CONIL, 1877, pp. 26, 27.—BRAUN, 1883, p. 212.—NEUMANN, 1888, p. 95.—IDEM, 1892a, p. 100.—IDEM, 1892b, p. 103.—The Lancet, 1892, I, p. 756.—Veterinary Journ., 1892, XXXIV, pp. 336–337.—MOSLER & PEIPER, 1894, p.

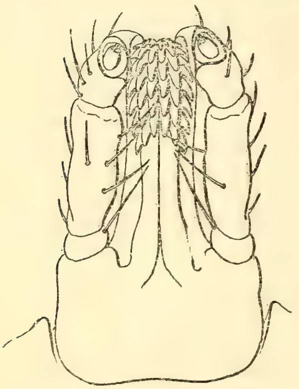
FIG. 238.—Ventral view of capitulum of *Amblyomma americanum*. Original.

Female.—Young: Body slightly more elongate oval than the male, 4.5 mm. long (including capitulum), 3 mm. broad. Scutum triangular in its posterior two-thirds, with posterior angle large and slightly curved, as broad as long (2 mm.); reddish brown with a white or metallic greenish yellow spot (after being in alcohol) in the posterior angle; cervical grooves deep in front, very broad and superficial in their

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321.—WOOD & FITZ, 1897, p. 346. [See also NEUMANN, 1897, p. 366, as syn. of *Dermacentor americanus.*]

1844: *Amblyomma americanum* (Linnæus) KOCH, 1844, p. 229.—IDEM, 1847, pp. 90, 91, pl. XVII, figs. 62, 63.—NEUMANN, 1899, pp. 201, 204, 209–211, 212.—WARD, 1900a, p. 204.—IDEM, 1900b, p. 436, fig. 258.—SALMON & STILES, pp. 474–477, figs. 236–255.

1844: *Amblyomma oblongoguttatum* KOCH, 1844, p. 228.—IDEM, 1847, p. 83, pl. XV, fig. 83; from Brazil. [See also NEUMANN, 1899, p. 209, as syn. of *Amblyomma americanum.*]

1867: *Ixodes unipunctata* PACKARD, 1867, pp. 66, 67 (Pennsylvania).—RILEY, 1887, p. 745. [See also NEUMANN, 1899, p. 200, and WARD, 1900b, p. 436, as syn. of *Amblyomma americanum.*]

1870: "*Ixodes unipictus* Packard" of VERRILL, 1870, p. 118 (lapsus for *I. unipunctata*).

1877: "*Ixodes americana* (Linnæus) Koch," of MURRAY, 1877, p. 194.

1880: "*Argas americanus* de Geer" of MÉGNIN, 1880, p. 134 (in part).

1886: *Amblyomma Foreli* STOLL (1886, p. 21, pl. XII, fig. 3; pl. XIV, fig. 3). [See also NEUMANN, 1899, pp. 209, 211, as syn. of *Amblyomma americanum.*]

1892: "*Amblyomma unipunctata*" (Packard) CURTICE, 1892b, pp. 226, 228–229, 234.—

posterior half; punctations numerous, small, equal, regularly distributed; eyes toward anterior third, similar to those of the male. Dorsal surface crossed by a marginal groove, equally distant from the border, limiting in back eleven festoons; punctations and wrinkles numerous, rendering the surface shagreened; hairs fine and not very numerous. Genital pore at height of coxæ II to III. Stigmata whitish, broad, triangular; stigmal surface finely punctate; stigmal pore small on elongate ridge. Capitulum 1.1 to 1.5 mm. long, differs from that of the male in the following details: Base longer; porose areas present, small, circular, oval, distant, divergent. Digit of mandibles 175 μ long. Palpi straight, second article relatively long. Legs thin, long, with long hairs; spine of coxæ IV scale-like, very short; tarsi long; tarsi I more than four times, tarsi IV four times as long as broad.

Fecundated and gravid female may attain 12 mm. in length by 8 mm. in breadth.

Nymph.—Body oval, swollen, 3 mm. long by 2.2 mm. broad, deep dirty gray. Shield relatively broader, reddish, without spot in alcohol specimen.

This tick has a wide distribution in North America and extends down into South America. It is more or less common on cattle and has also been found on man.

As stated on page 456 there has been considerable confusion as to the species which Linnæus originally named *Acarus americanus*. Linnæus's name is based upon a tick reported by Kalm (1754) from Pennsylvania and New Jersey, and described as "*Acarus ovalis planus, macula dorsali alba.*" This description clearly covers the most characteristic feature of the Lone Star tick; at the same time we are not inclined to deny that Kalm's description might also be interpreted as referring, in part at least, to *Dermacentor electus*. De Geer (1778) both described and figured what he supposed to be Linnæus's *Acarus americanus*, although he changed the name to *Acarus nigua*. De Geer's figures show beyond a question that the species he had before him was not a *Dermacentor*, but that it possessed the long palpi of the subfamily Ixodinæ, and also that it possessed the prominent spot on the posterior angle of the female scutum seen in *Amblyomma americanum*. There appears, therefore, little or no ground for doubt regarding the identity of De Geer's *Acarus nigua* with *Amblyomma americanum*. And even if we admit that Linnæus's description may be interpreted as covering both *Dermacentor electus* and *Amblyomma americanum*, it is necessary to accept De Geer (1778) as the first reviser who established the species to which *Acarus americanus* should be applied. On the rule of the first reviser, therefore, *Acarus americanus* Linnæus (1758) should be placed in the synonymy of *Amblyomma americanum* instead of in the synonymy of *Dermacentor electus*. The specific name *americanus* was subsequently transferred from *Acarus* to the genera *Rhynchoprion*, *Argas*, and *Dermacentor*, the various authors in question believing that they were dealing with Kalm's original form, and overlooking the important illustration published by De Geer. It is

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IDEM, 1892c, p. 237.—FRANCIS, 1894, p. 451.—MAYO, 1897, pp. 126, 127.—NILES, 1898, pp. 26, 27, 30, pl. I, figs. 1–4.—IDEM, 1898, pp. 46–50.

1896: "*Amblyomma unipuncta*" (Packard) of OSBORN, 1896, p. 261.—MAYO, 1897, pp. 126, 127.—MORGAN, 1899, pp. 128, 129, 130–133, 134, 141, pls. III–IV.

1896: "*Ixodes amerikanus*" of SCHNEIDEMÜHL, 1896, p. 340.

1896: "*Amblyomma amerikanum*" of SCHNEIDEMÜHL, 1896, p. 340.

1899: *Amblyomma unipunctatum* (Packard) of NEUMANN, 1899, p. 211, as syn. of *Amblyomma americanum*.

1898: "*Amblyomnia unipuncta* Pack." of DALRYMPLE, MORGAN & DODSON, 1898, p. 241 (misprint for *Amblyomma unipunctatum*).

1899: "*Amblyoma unipuncta* Pack." of LEWIS, 1899, p. 3 (misprint for *Amblyomma unipunctatum*).

very evident, however, that the name *americanus* has been used to cover a number of perfectly distinct species. In establishing the synonymy it is impossible in all cases to recognize with certainty the species which a given author has had under consideration, and in this event one is compelled to base his action largely upon the technical name adopted by the author in question.

GENUS HYALOMMA[1] Koch, 1844.

GENERIC DIAGNOSIS.—Eyes present, occasionally hemispherical, brilliant, in a submarginal orbit of the scutum; or flat, scarcely salient. Capitulum long, palpi valvate. Anal groove semicircular, opening forward, uniting the sexual grooves, and followed by a median ano-marginal groove. Body elongate oval. Color more or less deep brown.

Male.—With two pairs of ventral shields: two adanal, triangular, large; two lateral of these, smaller, straight; further, frequently two accessory shields posterior of the adanal. Stigmata comma-shaped, tail long. Scutum festooned on posterior margin. Tarsi calcarate.

Female.—Stigmata triangular; posterior margin festooned before replete stage.

TYPE SPECIES.—*Hyalomma ægyptium* (Linnæus).

Neumann recognizes three species of this genus, none of which appear to have been collected in North America.

KEY TO THE SPECIES OF THE GENUS HYALOMMA.

1. *Eyes salient; coxæ I incised* 2
   Eyes flat; coxæ I not incised; scutum with numerous equal punctations; median border of adanal shield longer than posterior border; only the male known .... *H. crassitarsus.*
2. *Scutum with numerous unequal punctations; median border of adanal shield longer than posterior border* .... *H. ægyptium.*
   Scutum with few, equal punctations; median border of adanal shield shorter than posterior border .... *H. affine.*

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